# AGRICULTURAL ENGINEERING

*Established 1920*

This journal is owned, edited, and published monthly by the American Society of Agricultural Engineers.

Editorial and advertising departments at the executive office of the Society, Saint Joseph, Michigan. Publication office at Benton Harbor, Michigan.

RAYMOND OLNEY
*Editor*

RALPH A. PALMER
*Associate Editor*

OFFICERS AND COUNCIL
OF THE A.S.A.E.

GEO. W. KABLE . . . *President*
R. H. DRIFTMIER . . *Councilor*
B. D. MOSES . . . . *Councilor*
E. A. SILVER . . . . *Councilor*
E. G. MCKIBBEN . . *Councilor*
C. E. FRUDDEN . . . *Councilor*
R. W. CARPENTER . . *Councilor*
K. J. T. EKBLAW . *Past-President*
E. E. BRACKETT . *Past-President*

RAYMOND OLNEY, *Secretary-Treasurer*

The A.S.A.E. is a member of
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
AUDIT BUREAU OF CIRCULATIONS

ADVERTISING REPRESENTATIVES

Chicago: DWIGHT H. EARLY
100 North LaSalle St.
Telephone: Central 4158

New York: A. M. WILLCOX
420 Lexington Ave.
Tele: LEXington 2-4816

SUBSCRIPTION PRICE: To non-members of the A.S.A.E., $3.00 a year in the U. S. and possessions and in Americo-Spanish countries, $3.50 a year in Canada, and $4.00 a year in all other countries; to A.S.A.E. members anywhere, $2.00 a year. Single copies (current), 30 cents each.

POST OFFICE ENTRY: Entered as second-class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

The American Society of Agricultural Engineers is not responsible for statements and opinions advanced in its meetings or printed in its publications; they represent the views of the individuals to whom they are credited and are not binding on the Society as a whole.

TITLE: The title AGRICULTURAL ENGINEERING is registered in the United States Patent Office.

COPYRIGHT: Copyright, 1941, by the American Society of Agricultural Engineers.

## CONTENTS FOR JULY 1941

*Volume 22, Number 7*

EDITORIALS ..... 244

PROBLEMS IN TRAINING AGRICULTURAL ENGINEERS ..... 245
*By E. E. Brackett*

HOW FARM MACHINERY HAS BENEFITTED SOUTHERN AGRICULTURE ..... 247
*By R. M. Merrill*

RESEARCH PROCEDURES ..... 249
*By W. D. Ellison*

BLOWERS FOR FROST PROTECTION ..... 252
*By C. I. Gunness*

NEW DEVELOPMENTS IN SMALL ELECTRIC MILK PASTEURIZERS ..... 253
*By D. E. Blandy and Maurice W. Nixon*

SHRINKAGE OF ARTIFICIALLY DRIED SEED CORN ..... 256
*By R. H. Wileman*

IRRIGATION PUMPING WITH ELECTRIC POWER ..... 257
*By Aldert Molenaar*

ONE-CAN ELECTRIC MILK COOLERS ..... 259
*By John E. Nicholas*

THE TEST OF TERRACING PRACTICES ..... 261
*By Earl L. Arnold*

A FLOOD CONTROL AND WATER CONSERVATION PROJECT 262
*By W. L. Powers*

HYDRAULIC HEAD MEASUREMENTS IN SOILS WITH HIGH WATER TABLES ..... 263
*By R. E. Moore and Kenneth R. Goodwin*

FLAXSEED PRODUCTION PROBLEMS IN THE SOUTHWEST ..... 265
*By E. S. McFadden*

FARM BUILDING SERVICE FOR THE SOUTHWEST ..... 266
*By Deane G. Carter*

NEWS ..... 267

AGRICULTURAL ENGINEERING DIGEST ..... 270

# EDITORIALS

## The Agriculture in Agricultural Engineering

AS A methodology, engineering has proven strikingly effective in the mastery and application of some branches of physical science, to the utilization and conservation of some natural resources and human values, in certain phases of human endeavor and progress. In fact, engineering has proven so effective in its characteristic fields of accomplishment as to suggest extension continually of its usefulness by increasing the range of science, resources, and human activities with which it works.

Our point is that the usefulness of engineering in agriculture might be extended by a keen appreciation not only of the potentialities of engineering methodology but of agriculture as a field of opportunity for its application.

What is agriculture, in terms of science which engineers can apply, material and energy resources which they can master, and human activities in which they can show ways to improved effectiveness?

When and at what rates can its functions proceed, in terms of time factors, cycles, and intervals tangible to engineers?

Where can engineering be applied in the structure and organization of agriculture, in terms of the three-dimensional place and space relationships of its physical entities and operations, and in significant magnitudes ranging from the microstructure of soils to production and market area distribution?

Why should engineering be applied in agriculture, from the standpoint of practical possibilities of helping farmers achieve their economic and social objectives?

Agriculture involves quantitative natural science, which engineers are demonstrating their ability to apply in increasing quantity, variety, and refinement.

Agriculture involves the development and utilization of mineral, organic, and energy resources, characteristic concerns of engineering.

Agriculture involves production and living, with all that these activities imply in terms of structures, machinery, electrical applications, utilities, transportation, and other engineering aids.

It is not so much in the development of large individual projects, but in the handling of a multitude of small matters of immense aggregate importance, and the development of equipment, principles, and practices which can be utilized by people who are not engineers, that agriculture calls for engineering service.

A considerable amount of ready-made technology has been available to agricultural engineers, as a by-product value of science applications by other branches of engineering for non-agricultural purposes. Agricultural engineering got its start as a way of helping agriculture with whatever existing engineering technology proved applicable to improvement of farming equipment, methods, and results. Agricultural engineers become acquainted with this ready-made technology as a necessary part of their basic training, and grow continually more familiar with it in their daily work. It is science in its most applicable form. It is a logical first place to look for means of solving agricultural engineering problems. But it is by no means the limit of development of agricultural engineering technology.

Agriculture provides opportunity for engineering applications of sections of science for which other branches of engineering have as yet found little or no use; and for application, in different magnitudes and significance, of much of the science they have used.

In applying new engineering to an old art, there is a constant pressure and temptation to concentrate on immediate and superficial objectives. For example, there is legitimate, tangible need of mechanical and structural improvement of many farm tools and buildings; but an objective scientific analysis of their functions and operations in items of agricultural objectives rather than mechanical performance may, in the long run, offer the soundest basis for such improvement. In the last decade or so several time-honored farm practices have been proven useless or actually damaging to crop and livestock production. No amount of superficial engineering refinement could have made them worth while. The only sound foundation for agricultural engineering is cooperation with agricultural scientists to determine, from the ground up, what features of agriculture are scientifically sound and worthy of engineering refinement, and what other features need a completely new approach; to reveal the points and directions in agriculture in which the extension, development, and application of engineering can be most effective.

The methodology of engineering is so exacting; original training, keeping up to date, and routine performance require so much time and effort as to tend to discourage and limit the development of informed, inspired, broad vision of its full range of opportunities. It is easier to develop and apply the technology intensively within its established range than to use the methodology to apply science not previously used by engineers to resources and human problems outside of their previous line of experience.

If the general public is to be able to take it for granted that engineering service to agriculture will be extended and increased, agricultural engineers can not take it for granted, but must work toward it consciously and effectively, with balanced appreciation of the power of their methodology and of its need of direction based on understanding of the field in which it is applied.

## Carrying On

JUST as many another office, shop, farm, and so on are being required to make adjustments due to valued workers leaving their jobs to join the nation's military and naval services, so is the headquarters office of the A.S.A.E. finding it necessary to carry on during the ensuing year at least without the services of the assistant secretary, Ralph A. Palmer, who, holding a reserve officer's commission of the rank of captain, was recently ordered to active duty.

Captain Palmer was also associate editor of AGRICULTURAL ENGINEERING, and his editorials, appearing on this page in recent years, have been widely read and warmly praised by A.S.A.E. members. The duration of his absence is of course quite uncertain at this time, but in the interval the page must needs be filled.

While the editorial page of this journal is always open to Society members to express points of view appropriate to this space, they are now more than ever encouraged to brave the editorial blue pencil and avail themselves of the privilege. Many members, as we know from intercourse with them, have highly constructive, thought-provoking views on a variety of subjects of immediate interest to agricultural engineers. This page offers an ideal forum for presenting them. Who will be first?

AGRICULTURAL ENGINEERING

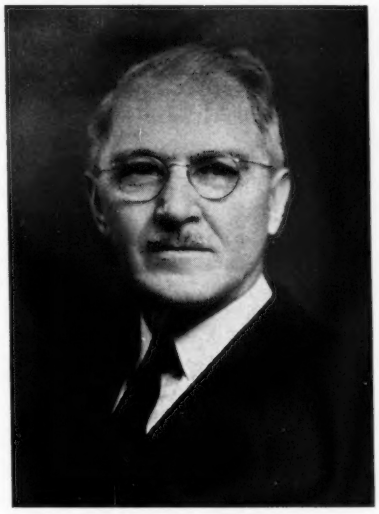
VOL. 22 JULY 1941 NO. 7

# Problems in Training Agricultural Engineers

By E. E. Brackett

FELLOW A.S.A.E.

AFTER six years we return to the southeastern part of the United States for this 34th annual meeting of the American Society of Agricultural Engineers. It was seventeen years ago that we ventured the hazard of transferring the date from winter to summer. The change of date and place met with hearty response and has been followed each year by migrations of increasing numbers of our members to widely scattered places. These meetings have induced us to travel to new scenes, broadened our firsthand knowledge of our country, and given us a keener appreciation of some of the problems involved in developing a well-balanced, unified nation. In this way the Society has carried its objectives to many who were uninformed or misinformed, and this better understanding of our Society has been of mutual value, adding materially to the recognition of agricultural engineering so eagerly sought by the founders and members in the early years of our organization.



E. E. BRACKETT
President, A.S.A.E., 1940-41

The wide range of engineering applications in agriculture was realized, in part at least, by the founders of this Society. With a small membership the problem of one was the problem of all. Increase in our membership roster has changed this picture, and the general sessions of our annual meeting now occupy only a small portion of the time of our meeting program. Our fields of activity have become diversified. Subdivisions have been formed and many members find themselves fully occupied in the one division of their major interest. They are contributing to the technical programs, and their papers are overcoming the "dearth of literature" which was the complaint voiced by one of our early presidents.

Mechanical equipment has been given its full share of attention by the Society. This attention was needed and is still needed. Better design, better performance, better values continue to appear and meet with ready public acceptance. Along with this improved equipment and more efficient methods of crop production, we hear many questions raised that as yet have not been fully and satisfactorily answered. A recent magazine article presents an interesting discussion of this phase of agriculture, and I quote from its closing paragraphs: "In the heat of conflicting views and interests, men often debate eloquently over spurious issues, and leap to doubtful remedies. Little clarification is likely to come from discussion framed by the question: 'Is the goal of efficiency in agriculture socially desirable?' There is no point to attacking the machine. Proposals for graduated land taxes and special taxes on farm machines are of questionable value, certainly unless they are fitted into a broader and more constructive program than their sponsors have yet propounded. They lead to altercations over false issues, and obscure real ones. . . . The real question is not: Are we for or against more farm machines? It is: How can we distribute the benefits that more machines in agriculture can confer? How can we use them to create, not poverty, fear, and disunity, but well-being, security, and unity among all our people on the land? So long as we leave that question unsolved, we are neglecting a sure foundation of our defense."

It is certainly a part of our duty as engineers and responsible citizens to assist in the correct solution of this problem.

Another phase of agricultural engineering which occupied the attention of the founders of this Society was rural architecture. Some favorable results have been accomplished, it is true, and our influence may be seen—but only in spots too widely separated.

Why have our efforts not been more effective? Is it because our designs are too costly, unattractive, or otherwise inadequate? Is it because we have failed to make the proper analysis upon which to base design? Have we allowed a rampant "uplift" motive to distort the true picture and cause us to ignore basic economic factors essential to a solution that will stand the test of time?

Competition for a place in the market becomes more keen as new materials appear. Some of these materials have not lived up to expectations; claims may be excessive or information on physical characteristics and suitability may be lacking. Here again our Society is involved. If we continue to claim proficiency in this field it is a part of our duty to assist in securing and making available additional data and information which will leave little excuse for misuse of any material and which will be of real value in the production of sound economical designs.

On our program this week appears the topic "A National Program for Farm Building Improvement". The possibilities involved are tremendous, and our connections in this field will bring added responsibility to this Society if the program gets under way as planned. Again we will have calls for personnel we are unable to supply.

Another example of the broad vision of our charter

Address of the President of the American Society of Agricultural Engineers before the 34th annual meeting of the Society at Knoxville, Tenn., June 23, 1941. Mr. Brackett is professor and head of the agricultural engineering department, University of Nebraska.

members is indicated by their interest in conservation. Their pioneer work had its share of influence in bringing about the recent nation-wide activity in this field and in bringing to wide public attention the significance of the hazard of soil erosion to our national welfare.

The closely related studies of our natural resources and land use are being followed by the large and active part of our membership whose major interest is our Soil and Water Conservation Division. The scope of the programs of this division is ample evidence of a continuing breadth of vision which should give us confidence that the engineering problems in this field will be solved by men well informed and thoroughly qualified.

It is doubtful if any of the founders of this Society in his most rosy visions saw the thousands of miles of rural electric service lines of today, and the most optimistic visionary scarcely expected them to come in his lifetime. We have cause for pride in the part we have taken in this development.

### COMPETITION FOR QUALIFIED MEN

These major phases of agricultural engineering, with their allied branches, are today competing with other lines of engineering and business for the services of properly qualified men. It has been the primary business of many of our active members (several of them charter members) to train young men for effective service in agricultural engineering. Our College Division and committee activities center on the problems of education of agricultural engineers. As persons responsible for the content of the curricula offered by our colleges, and as advisers of our students, we are not always in agreement. Certain basic fundamentals must be supplemented, and these supplements are chosen with the best judgment of those in charge in widely separated colleges—perhaps with local conditions of demand and with many limiting restrictions as important factors. In other words, we each offer a program of training which we believe to be adequate and which circumstances permit. Is this as it should be? What do employers think about our product? Does our idea of adequate training agree with theirs? The answer may be no. The major difficulty is usually to get *any* constructive suggestions from employers, and if any do come, they may represent the wide range between the man who complains because the youngster cannot qualify as a journeyman in one of the trades, and the supervisor of a carefully planned industrial training course, into which the young graduate will be inducted. One may be disappointed, the other entirely satisfied.

Some experiences lead me to believe that, on occasion, prospective employers deliberately submit specifications of qualifications for applicants, which they probably know can not be met by any of the graduating group being considered. The writer of the specifications *might* have thought (1) that this would limit applications to the top men of the class, (2) that it would discourage *any* applications, (3) that it might forcefully arouse the instructor to the deficiencies of his product. The visits of personnel officers to colleges have become recognized procedure. Usually these representatives are well qualified to make their estimates of the students they interview and to answer questions as well as ask them. Occasionally a representative appears unable or unwilling to give pertinent information to which the student is entitled.

There is another type who comes without advance notice, announces his arrival by telephone, in the same breath says he must depart in an hour or two, and seems to think that all activities and commitments should be waived for his benefit in the meantime.

Still another writes, indicating dates on which he will be present to interview prospects, then fails to appear and no letter or other communication follows by way of explanation.

Next is the one who writes that he will not come this year, then at the eleventh hour, telephones that he will be in next day and hopes to get the pick of the class.

Then there is the representative from the large company, who gives assurance that he alone will come from his concern this year, but who is followed in a few weeks by one from another department—too late.

These cases are cited, not in criticism, but to emphasize the fact that this is one phase of our activities that still needs attention.

Another phase has to do with student contact with possible future employers during the summer vacation periods. Members of our Power and Machinery Division are largely responsible for the Industry Seminar conducted each of the past three years under A.S.A.E. sponsorship in cooperation with farm equipment manufacturers. Two students, a senior and a junior from each agricultural engineering department, are offered the rare opportunity to see some of the realities of industrial production, and to hear some of the key men of the different companies discuss such subjects as supplies, transportation, safety, labor relations, design, advertising, and sales.

The men chosen to make this trip must have shown their major interest to be in the field of farm power and machinery. In the eyes of the student, selection for this Seminar is a real plum. And it also has its influence on his classmates—a good influence in stimulating interest and effort in that line of work; perhaps in some cases not so good, in diverting students to that field who have better possibilities in other lines.

These seminars have been of tremendous value to the fortunate students and of no less value to the faculty men who have attended. The field of farm machinery and power is not the only one which can benefit by this type of activity. Other divisions of our Society might well consider sponsoring something of a similar nature. Our students need to know more about the nature of the employment they may expect to find. They need to see something of it, and they want to hear about it from you men who are actively engaged in it.

### BUSINESS AND PROFESSIONAL PERSONNEL REPLACEMENT PROBLEMS

Another opportunity for cooperation largely overlooked to date is that of summer employment of students particularly those who have another year or half year of college. These young men need experience—they are eager to get it and every day, every hour of experience they can get on the job is a real asset far in excess of the dollars earned.

What are the first questions asked of them by prospective employers? "What can you do?" "What experience have you had?" Obviously these summer jobs will usually be of subordinate character. Perhaps you think the college boy would not be interested. But give him a trial; it will give him a chance to see first hand some everyday operations of your business; it brings him in touch, probably for the first time, with a going concern that is a factor in his world of the future; it gives him a better understanding of what is ahead and he brings it back with good effect on his remaining college work. It gives you an early opportunity to size him up; *(Continued on page 248)*

# How Farm Machinery Has Benefited Southern Agriculture

By R. M. Merrill
MEMBER A.S.A.E.

SOME authorities have gone so far as to say that the progress of modern civilization has been largely dependent on progress in the development of farm machines. Their reasoning is something like this: Agricultural workers have been able to increase their productive capacity to such an extent that great numbers of the agricultural population were released to follow other pursuits, including the professions, arts, and sciences. Regardless of whether or not mechanical equipment has been the major factor in the progress of agriculture, it seems apparent that it, together with the great advancement in knowledge of soil fertility, plant breeding, and insect and disease control, has enabled the individual agricultural worker to increase production greatly and at the same time maintain a higher standard of living than ever before.

Southern agriculture has benefitted by the use of larger and more efficient power units and farm equipment, but not to such an extent as has the country as a whole. There have been many reasons for this lag in the adoption of improved methods and equipment in most sections of the South. Probably the two most influential factors have been the topography of farm land and the type of agriculture.

Notwithstanding the large amount of hand labor required for the chopping and picking of cotton, data are available to show the reduction in total cost of production by use of the more efficient units of power and equipment.

## SOIL CONSERVATION ENCOURAGED

Lowering the man hours of labor required for producing the cotton crop is only one of the contributions which power and machinery have made to the progress of southern agriculture. The use of larger and more effective power units enables the operator to carry out the recommended practices for soil building and soil conservation which are practically impossible with the small power unit consisting of perhaps one mule or one horse.

The agricultural engineers are probably responsible, at least in part, for the fact that when farm power is mentioned, the average listener immediately thinks of tractors. This should not be the case, since the horse and the mule are certainly sources of farm power and will continue to be, at least in certain areas, for many years. By advocating the use of larger and more efficient power units, one does not necessarily mean the use of tractors. If two mules are available instead of one, the power unit is doubled and more efficient tools may be used. A team of 1,100-lb mules and a 12-in walking plow appear to be a big unit to anyone who is trying to turn a winter legume crop with one 700-lb mule and a 6 or 7-in plow.

Results in all areas of the South show that turning under winter legumes aids greatly in building up the soil, but that in many cases the limiting factor in the extension of this practice has been the lack of power to plow under the legumes in the spring, before cotton-planting time. With sufficient power this practice presents a less serious problem.

A paper presented before a meeting of the Southern Section of the American Society of Agricultural Engineers at Atlanta, Ga., February 5, 1941. Abridged. Author: Agricultural engineer, Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture.

Another contribution of ample power toward the welfare of agriculture has been that it has made possible the construction and maintenance of terraces to prevent soil washing.

As improvements in equipment and practices have reduced the time required for field operations in cotton, more labor has been available for growing feed and food crops so essential to a diversified agriculture. For example, it has been observed that on one large plantation a considerable acreage of oats is now being harvested annually by a few men and a combine, without disturbing the cotton field activities in any way. In 1924 and 1925 this 8,600-acre plantation was raising about 3,400 acres of cotton by the share-cropping tenant system, with only small acreages of corn, oats, and hay, and a little livestock. Under these circumstances 175 one-mule plows were used. With the introduction of tractor equipment, the farming system gradually changed until, in 1940, the same plantation had about 1,200 acres in cotton, 3,000 acres in corn, oats, and hay, and about 300 acres in truck crops. The operations by share croppers have decreased to a total of ten plows, and the remainder of the plantation is being operated by the wage-laborer system, using 12 tractors and accompanying tractor equipment. A few mules and mule equipment are used for working in the few places where larger units are not feasible. The production of cattle and hogs is now one of the major enterprises on the plantation.

## LITTLE LABOR DISPLACEMENT

One of the most interesting features about this plantation is the fact that it is supporting approximately the same number of people as when the share-cropper system was in use. These people are living on the plantation and working as wage laborers, operating tractor equipment, hoeing, chopping and picking cotton, furnishing labor for the other crops, and caring for livestock.

Although it is difficult as yet to show figures to indicate the extent of changes being brought about by the adoption of new equipment, many observers have noted developments similar to those on this plantation. The reduction in labor necessary for each crop, the ability to get certain operations done quickly and at the proper time, and the better quality of work done when ample power is available are all factors in the change to a more diversified and productive agriculture.

The change to the use of larger power units may come slowly and in a small way. With the present knowledge of soil-building practices, an improvement program can be carried out with a power unit of two good mules and a two-mule equipment. The extensive experimental work now in progress may show some way by which a one-mule unit can be used to carry on an improvement program; but at present, under most conditions at least, it seems almost impossible.

In order that southern agriculture, particularly in those states where hand methods and one-mule equipment are still widely used, can make the most effective use of improved methods, much educational and demonstration work must be carried on. This is not surprising when it is

remembered that in these areas there has been no gradual evolution of farm machinery and methods as has occurred in the corn and wheat belts. The changes from walking plow to riding sulky plow, gang plow, and tractor plow, and simultaneous changes in cultivating and harvesting equipment, have covered a period of many years; the skill of the operators of the improved equipment has also developed gradually. There is no doubt of the fact that the use of modern efficient farm tools with greater power and higher speed requires more intelligence and skill than does the operation of more simple tools. The mere acquisition of a tractor does not necessarily mean that the owner immediately becomes a successful farmer. Whether or not the equipment is of economic value to the owner is largely dependent on the manner in which it is used.

The problem of assisting those farmers who are attempting to initiate the use of more efficient power units and equipment is a challenge to all agricultural engineers, whether they are in research, extension, teaching, or in commercial work. The manner in which a farming operation is carried on and the equipment with which the operation is performed determine, to a great extent, whether or not the operation is economically sound. An endeavor should therefore be made to obtain and maintain a recognition of the importance of farm power and equipment in any program designed to improve agriculture. For example, in many agricultural production experiments, the questions of how to do the actual field work and what equipment to use are not given much thought; too often this is left for the field man to carry on with whatever tools he may have available.

### FARM YOUTH ORGANIZATIONS AID TRANSITION

Since, as stated previously, southern agriculture in many areas is making the change from one mule and a Georgia stock to a tractor and power tools, without going through a more gradual transition, it may take some time to get the greatest benefit from the use of this new equipment. It would seem that the greatest progress in this development might be through the farm youth organizations, such as the 4H Clubs and the Future Farmers of America. These boys and girls are interested in better farm equipment; they welcome any opportunity to become more familiar with it and to learn how it can be used to advantage on their farms. In many places local implement dealers are cooperating with the vocational agricultural leaders in working with farm boys and girls to the advantage of everyone concerned. Since the factors of power and machinery are exerting such an influence in the progress of agriculture, training in how to care for, and to make the best use of this equipment should certainly hold a prominent place in all educational programs planned for farm young people.

In conclusion, it should be emphasized that although the increased use of more efficient farm mechanical equipment has aided greatly in the progress of southern agriculture in certain areas, the great majority of farmers are still struggling to compete by using the old laborious, slow, and inefficient methods. One important feature of modern farm equipment is that its adoption by any portion of the farming population increases the handicap of those farmers who, for some reason, do not or cannot make use of it. Agricultural engineers have a great responsibility in giving assistance wherever needed to bring about the most effective and economic use of equipment which has been designed to get the most returns from the land with the minimum outlay of time and energy.

## Problems in Training Agricultural Engineers

*(Continued from page 246)*

to see if he "can take it"; to see if he is one you may want as a permanent employee later. It brings real satisfaction as the boy returns to finish his work in college, when his summer employer writes, "I want to keep track of that lad. We will need him again as a regular."

Replacements are a vital consideration in maintaining any farm, factory, office, or other going concern. Training within the organization is common practice. New personnel is needed from time to time and many of you come to our colleges. You come hoping to find young men of ability, character, and personality who can be employed with reasonable assurance of success. For those of us in college work, it is a major objective to make such men available to you.

The quality of these replacements is a matter of utmost importance. As employers you may think of it as the job of the colleges. But you have a share in that responsibility which has already been indicated. We must know your needs, expressed in terms of college courses, if we are to serve you best. I believe we have enough employers who are interested to attack this problem at once, and I now recommend that a committee be appointed consisting of one or more employers from all divisions of the Society (except the College Division) to study the training requirements considered essential in their respective fields. To be effective this must be more than a superficial, generalized survey, and should be followed by specific recommendations. If this can be carried out, I feel sure there will be a hearty response and far-reaching beneficial results.

This matter is of vital importance to our Society as a technical engineering organization. It also has the problem of replacements. Ours is not an old organization, but many of its charter members are gone and each year sees the passing of some member whose contributions have had their part in bringing the Society to its present position in the engineering world. Replacements must join us, and the Society must see to it that these replacements meet standards of qualification second to none.

### SERVICE IN WAR AND PEACE

Our enormous program of preparation for adequate national defense brings thoughts of other replacements. A year ago a formal tender of our services was made to the authorities in Washington. Developments have not yet reached the stage where this Society has been assigned any specific duty. It is probable that our assignment will come at no distant date. Many of our members are already in the military service. Others will soon be going. More replacements of men and still others of ships, airplanes, and materials, going for purposes we all regret, but which at present seem necessary.

Experiences of some twenty years ago warn us to have ever in our minds the still greater problems of replacements and adjustments when the present defense program is over and peace is at hand.

It appears that we can truthfully say the great agricultural industry of the United States is in the best state of preparedness for war of any in the country. It should be no small source of pride to members of this Society that they have had a major part in this achievement.

Many years ago we were told that "the future of A.S.A.E. is based on service, and the better the service which it renders the greater will be its success." The spirit of service continues to motivate our members. And thus the American Society of Agricultural Engineers goes forward with assurance of continued success.

# Research Procedures

By W. D. Ellison
MEMBER A.S.A.E.

RESEARCH procedures is a complex and challenging subject, complex because it embraces all known methods of advancing our knowledge and because the details of procedure may change with each change of research objective. It is challenging because better ways of studying and advancing our knowledge about unknown things are always to be found in improved research procedures, and because all of us must practice research regardless of whether or not we are on a payroll as research workers.

Dr. M. L. Nichols[1]* says: "Research, no matter in what field, is primarily a process consisting of a systematic investigation of some phenomenon or series of phenomena to discover facts or the natural laws controlling them."

According to Earl S. Patch[2], " 'Research', properly practiced, is differentiated from its antecedent 'experiment' in that it is characterized by a broader and more precise vision, a better and more orderly knowledge of fundamental units, a more complete, precise and accurate instrumentation, and a more thoroughly organized background. Experiments may include one or more of these characteristics, but when all are comprised, there is a logical development into research. This experimentation is merely an element of research.

"By virtue of the distinguishing characteristics of research, its results are fundamental and are comparable with results secured by the same method at other times, whereas the results of experiments are of value only in the case under consideration and at the time at which the work is done. Research determines the characteristics needed to accomplish a result or to reach a well-defined, practical objective, while experiment shows only the overall performance of a specific construction which may be merely an element of the ultimate objective. One is positive knowledge—the other immediate comparison, tinctured frequently with the faith and hope that so typify some inventors and designers."

Dr. Robert E. Yoder in a letter to the author has defined research as follows: "Research is the utilization of an efficient thought process, strongly supported by carefully planned experimentation, systematically directed and diligently pursued toward the solution of a fundamental problem."

For purposes of this discussion research is defined as study that is planned to gain basic information not available in the form it is desired. Various means of learning, such as through reading, committing to memory, consultations, reflective thinking, and observing and measuring results of experimentations, may be employed. Any one of these ways of learning is not in itself research, but each constitutes an element of research. The details of research procedure relating to different problems may vary, but throughout all research there have been principles of procedure that have usually been followed by those who have contributed to our basic knowledge.

Psychologists tell us we may distinguish four fundamental phases of the thinking process. These are recognition, suggestion or hypothesis, scrutiny and explanation, and prediction and verification. One difficulty some of us have in applying this outline to research procedures may be in assuming that everything about the problem remains static. It is probable that only the principal objective will remain static, and all of the separate factors of the problem must continue to be passed through processes of analysis until the final results are obtained. This requires that thought processes and the four phases they embrace be made an integral part of each step in research procedure.

Research procedure is primarily an orderly process for analyzing, planning, and conducting an inquiry. Some forms of inquiry are more effective than others, and to be most effective the inquiry must be scientifically planned. This planning must be done in such a way as to afford effective use of all answers obtained, whether these answers be positive or negative. An example of planned inquiry can be cited by referring to an experiment once conducted by the author. In this experiment two boys were taken into a room where there were eighty-five articles scattered about. The name of one of these articles had been written on a piece of paper, and one of the boys was to ask questions until he could name the article. To each question the boy would receive a "yes" or "no" reply. This boy thought the most direct approach was to start asking questions about the articles themselves, and so he started his laboratory work at that point. He started by asking about each article, and for him to name the specific article he required sixty-two questions. With this sort of approach each negative answer meant very little. At best the negative answer only meant he need not try that one again, and it did not guide him to the next question he should ask.

The second boy was assisted in planning his inquiry. The problem was analyzed and the inquiry planned in such a way that the results of a negative answer were about as effective as the results of a positive answer. In the analysis it was decided that position, material, shape, and specific name were the principal factors of the problem.

In reference to the location factor, the plan provided for dividing the room into quarters, and the quarter of the room which contained the article was located with two questions which were: "Is any part of the article in the north half of the room?" "Is any part of the article in the east half of the room?" From these two questions the article was determined to be located in the southwest quarter, and just twenty articles were contained in that section. In this way sixty-five articles were eliminated from the list of possibilities by two well-planned questions which narrowed down the location factor. In each case a negative answer had been obtained, but each negative answer had served to give positive direction to the inquiry.

The material factor was the next consideration and the twenty articles on the list of possibilities were found to be made of four different materials, leather, wood, steel, and stone. "Is the material of the article in question harder than wood?" brought a negative answer. Then, when the question "Is it wood?" brought a negative answer, the article was known to be made of leather. At this point four questions had been asked, and the story is here ended with the information that only six questions were required to identify the unknown article. The element of luck was no-

Paper presented at the 34th annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. A contribution of the Committee on Research.

Author: Project supervisor (Coshocton, Ohio), U. S. Soil Conservation Service; member, Committee on Research, A.S.A.E.

*Superscript figures indicate references cited at the end of this paper.

where apparent in this inquiry. With the planned approach that was used, six questions represented the maximum number that would ever be needed to locate that particular article under the conditions prevailing.

Research procedures are based on the principles of sound inquiry, and there are at least three basic steps involved in sound inquiry. The first of these is to designate positively the subject matter to which the inquiry is directed, the second is to determine the "when" and the "where" pertaining to the matter, and the third step is to determine the "how" and the "why". After the "what" has been definitely determined the "when" and the "where" locate *it* in its environment so that we can study and interpret the "how" and the "why".

The development of a research problem starts with some observation by one or more of the five senses. Here the word observation is used in a lay sense, and it implies any impression carried to the mind by one of the senses. Reflective thinking follows, and these thought processes may be cultivated by further observations. In this way the entire development moves forward until the research problem is defined and we are certain *what* must be investigated.

Observations relate only to positive things. They never relate to absolute negative matter, and they cannot be negative except by some standard of relative measure. Since research problems originate with observations and since we never observe negative matter, this limits our research to positive things. Included in these positive things, and fundamental to every observation we make, are factors of energy, time, and space. Since we have never made an observation that did not include these basic units we cannot conceive of matter without them. We cannot conceive of a universe which does not contain these three elements. They are part of everything we construct and they are a part of all knowledge. These facts make them a part of every research problem.

## A POSITIVE APPROACH ESSENTIAL IN SETTING UP THE RESEARCH OBJECTIVE

C. O. Reed[3] has said: "I believe you will agree from basic analysis that the most important and fundamental phenomenon in the sensible universe is change." He might have gone on to say that time, space, and energy are the most basic and fundamental units of all change, and that without all three of these elements there would never be change of matter. Also, that all research is based on an evaluation of change, and where there is no change there can be no research. These facts must be considered in developing the principles applying to research, and they are a consideration in all research procedures.

A positive approach should be adopted in setting up the research objective. For example, the research worker will not say that the beam will not support the load. He will say the beam failed. This will represent a statement of fact and only factual statements support the research problem.

Dr. Kettering[4] has said: "They talk about 'incurable diseases'. Incurable diseases are only those that the doctors don't know how to cure. It is not the disease that is at fault; it is the doctor." To Dr. Kettering's statement might be added, neither is there anything wrong with the curative measures for these diseases. The trouble is that they are not known. The research worker lists these cures as unknown and starts out to find them.

The first determination, of what is to be studied, must be well defined and fully analyzed before anything effective can be done in the second step of the inquiry. It is not possible to determine the "when" and the "where" of a particular thing, unless we are certain as to what the "when" and the "where" apply. After we know specifically the "what", "when", and "where", we can test and observe the unknown in its environment and determine the "how" and the "why". The last step in research procedure is the "why" determination. Usually if the inquiry has been properly planned, the data only need to be considered in the light of the planned experiments, and the "why" determination can often be made through data analysis.

In the interpretation of "how" and "why", the research worker must assume his full share of responsibility for the preparation of the results of research in a way that they can be used by those who make the application. This necessitates clear interpretations of the "how" and the "why" of the problem, and if this job is well done, the professional workers engaged in scientific application will then be able to determine the "what", "when", "where", "how", and "why" of the application. Or, in other words, if good research interpretations are made, the professional workers making application of the results obtained will be in fair position to decide what to apply, when and where to apply it, how to apply it, and why it should be applied.

## RESEARCH FACILITIES ARE DIVIDED INTO MENTAL AND LABORATORY FACILITIES

The preceding discussion relates primarily to the principles of research procedure without reference to the facilities for conducting research. It is recognized that all procedures are modified by the facilities available, and that the facilities must be used in proper relation each to all others. In a primary classification, the facilities of research may be divided into (1) the mental facilities and (2) the laboratory facilities. It seems almost unnecessary to say that full exercise of the mental facilities must precede use of the laboratory facilities. When we undertake the job of solving a problem in algebra or calculus, we attempt to evaluate one or more unknowns by use of standard equations. In this work we do not try to use our laboratory facilities (the pencil, paper, and standard equations) until we have made a mental review and analysis of the problem. We would not get far if we tried to find the answer by juggling all of the various results we could obtain through the use of standard equations. We know that we must do the analysis first and accept the data as an evaluation of the analysis.

Dr. Kettering[4] also said: "The only reason you try an experiment is to cultivate your own thinking. You set up an experiment and it does not work. That means you weren't thinking straight. You say the experiment failed. That is just an alibi."

Dr. M. L. Nichols once said he was not so much concerned about whether a man was thinking just right on a particular problem, but the main thing to him was whether or not the man was thinking. From Nichols' statement we can infer that, if he were lost with an airplane during a storm, he would not be nearly as interested in learning whether the plane was flying the shortest line toward the nearest radio beam, as he would be in learning whether the radio equipment was functioning so that there would be a chance to recognize the beam when it was reached.

Sound inquiry in research must be directed by and projected from a sound objective analysis. Sometimes a good analysis will show that no actual problem exists where one was once thought to be. Imaginary problems are sometimes set up through misunderstanding, and if every aspect of the problem is carefully considered in making the objective analysis, many mistakes can be avoided. R. W. Trullinger[5] has said: ". . . while the success of research has been

Advantages and disadvantages of cultivation pose some delicate research questions of soil handling practice. Immediate and long-time objectives in tillage, interests of current production and conservation, sometimes conflict. Farm objectives, biological requirements, and conditions imposed by nature are determining factors in farm machine design and power and labor application. Research is the efficient way of producing more knowledge of these determining factors and their many influences

thought to depend upon the individuality as well as upon the ability of the men engaged therein, and freedom of research initiative and action have been considered as among its first conditions, it is nevertheless true that effective coordination of the different scientific activities pertinent to an agricultural problem are essential to its most efficient and productive solution."

One of the early steps in objective analysis is to divide the factors of the problem into groups with each group representing a number of like factors, such as biological, physical, and electrical. This primary division will assist in giving direction to the analysis suggested by Trullinger and it will provide an outline to show some of the subject matter involved. A second step that must be taken early in the work is that of classifying all factors as constants or variables. Following this classification the factors must be associated together in such a way as to establish the functional dependence of the variables. Not until the dependence of variables has been established can a hypothesis be formed and experiments organized. Final evaluation of changes in the variable factors and confirmation of their dependent relations leads to the ultimate research objective.

In speaking of the organization of experiments, Dr. Frank B. Jewett[6] has said: "In the first place, if one is to make a single experiment and hopes to draw from it any definite conclusions, he has to make sure that the experiment, so far as is humanly possible, involves but a single unknown." He further explained that there must be an experiment for each unknown, but the point here is that the dependence of the variables must be understood before we can be reasonably certain that only one unknown is involved.

Analytical methods for the analysis of experiments may vary with changing antecedents as well as with changes in the experimental objectives of the various minor experiments. Mill's methods of experimental analysis are outlined in the book, entitled "Scientific Methods", by F. W. Westaway, (pages 203 to 212). These recognize two basically different types of comparison which are (1) comparisons of different instances in which the phenomenon occurs, and (2) comparisons of instances in which the phenomenon occurs with instances in other respects similar but in which the phenomenon does not occur.

Five methods are shown for making comparisons to assign relative values to the factors to which the data apply. These are:

1 *Matter of Agreement.* If two or more instances of the phenomenon under investigation have only one circumstance in common, that circumstance may be regarded as the proper cause (or effect) of the phenomenon.

2 *The Method of Difference.* If an instance in which the phenomenon under investigation occurs and an instance in which it does not occur having every circumstance in common save one, that one occurring only in the former, the circumstance in which alone the two instances differ is the effect, or the cause, or an indispensable part of the cause of the phenomenon.

3 *The Joint Method.* If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances (in the same department of investigation) in which it does not occur, having nothing in common save the absence of that circumstance, the circumstance in which alone the two sets of instances differ is the effect, or the cause, or an indispensable part of the cause of the phenomenon.

4 *The Method of Residues.* Subtract from any phenomenon such part as is known to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents.

5 *The Method of Concomitant Variations.* Whatever phenomenon varies in any manner, whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some fact of causation.

In some of our agricultural problems there are many sets of antecedents which affect the dependent variables, and each set may be composed of different combinations of factors, with each factor having a different value in each combination that it appears. Often these different sets of antecedents produce very similar effects under a variety of experimental conditions. Basic research which studies these factors one at a time or in some simple environment in order to verify their functional effects and evaluate their relative actions on the dependent variables and in the various combinations in which they may appear, is the only known way of approaching usable solutions to these problems. To do this the functional dependence of factors is first established, and this is followed by measurements to make relative evaluations. Controlled experiments may be needed in both of these studies.

In closing, it can be pointed out that the principal distinction between research and experiments is that basic research represents an organized study of "how" and "why" the variable factors vary, while experiments are usually for the purpose of evaluating an effect of some specific antecedent in certain combinations of factors. It is recognized

that the results of the experiment will apply only in the combinations and under the conditions represented by the experiments. An effect is not a basic relation and it may be positive or negative in either axis of a graph. It may fall in any one of the four quadrants with its final location being controlled by the antecedent with which it appears.

Dr. Yoder once said that he believed the most difficult part of successful research was the effort required for reflective thinking and the mental analysis that should continually be exercised throughout each step of the research undertaking. The fellow that minimizes this most difficult part of the job may ultimately get an answer, but he is very likely to be duplicating the approach of the boy that requires sixty-two questions to locate one article out of eighty-five.

It is difficult to close a discussion on a subject as interesting as research procedures. There is no such thing as *a* research procedure, no more than there is *a* way of life. There are principles of research procedures and these must be observed to assure effective research work. A very important principle of research is that clear thinking and keen observation must be maintained from the beginning to the end of the job. The fellow who stops analyzing his problem or neglects making keen observations either before, during, or after he completes his primary plan of attack, or at any time before his objective is attained, will invariably find himself in the position of the football player in offensive play who stops driving—he will not only be stopped, he will be down.

Research procedures to be most effective must be scientific procedures. One way to keep them scientific is to maintain a current objective analysis as the work progresses, current with the results of each experiment. This requires extra work, hard work, thinking, and where this is done, we find the most conclusive evidence that we have for proving the old adage "Science beats luck."

It is the author's belief that some research could well be done on research itself. Certainly there is vagueness about the "what", "where", "when", "how", and "why" of the subject of research. A research project set up to study and clarify the major principles applying to these aspects of research would be helpful to all research workers.

REFERENCES CITED

[1]Nichols, M. L. Organizing a Research Study (unpublished)
[2]Patch, Earl S. AGRICULTURAL ENGINEERING, January 1924
[3]Reed, C. O. The Engineering Approach to a Research Problem. Agronomy Seminar, Ohio State University, 1934
[4]Kettering, Charles F. Pitfalls in the Rocky Road of Research. An address at the Industrial Research Conference, Ohio State University, November 6, 1936
[5]Trullinger, R. W. AGRICULTURAL ENGINEERING, October 1940
[6]Jewett, Frank B. The Place of Research in Industry. Section III, Proceedings of 12th annual meeting, American Petroleum Institute, 1931

# Blowers for Frost Protection

By C. I. Gunness
CHARTER MEMBER A.S.A.E.

IT IS a well-known fact that crops on low land are more subject to frost than those at higher elevations and that frosts occur on still nights. Cold air being heavier than warm air will flow to valleys and hollows, while the warm air will rise to adjacent hills. Whenever a heavy breeze is blowing, the air motion is sufficient to overcome this tendency for warm and cold air to separate.

Still, clear nights not only tend to produce a temperature difference between hills and valleys but also produce a gradual rise in air temperature with elevation up to a point known as the "ceiling". This phenomenon is known as "temperature inversion" as it is contrary to the general condition of low temperatures at high elevations. The elevation of the ceiling is relatively low, ranging from ten feet to a few hundred feet. The amount of temperature inversion ranges from 0 to 10 or 15 deg, and 5 or 6 deg are quite common.

Orchardists in California first made efforts to force warm air from high elevations on to their trees by means of fans about twenty years ago. The results obtained from the use of blowers have been reasonably successful, and there now are about 150 plants in that state. Ben D. Moses of the California Agricultural Experiment Station has done considerable work on determining the effectiveness of these machines. He reports that of eighty-six plants in the Los Angeles area, twenty-eight are operated by gas engines and fifty-eight by electric motors. These machines protect 1885 acres with 7.4 hp per acre and represent an investment of $175 per acre. While they show considerable promise, they have as yet displaced very few smudge pots.

Paper presented before a meeting of the North Atlantic Section of the American Society of Agricultural Engineers at Farmingdale, L. I., N. Y., September 1939. Author: Head, agricultural engineering department, Massachusetts Agricultural College.

Cranberry growers in Oregon and Washington have used fans for frost protection for a number of years. They have used small second-hand automobile engines with 5-ft propellers, and many growers are apparently satisfied that the machines are worth while. The machines, however, are not in general use. There is considerable interest in wind machines for cranberry bogs on Cape Cod in Massachusetts. Our bogs are subject to severe frosts and more than half of the bogs are equipped with facilities for flooding at times of danger from frost. Even those growers who are equipped with good facilities for flooding are interested in blowers, as flooding is considered harmful to the crop and they would prefer to ward off light frosts with wind machines and flood only at times of a heavy freeze.

An experimental machine was put in at the state cranberry experiment station in 1938. It consists of an 8-cylinder automobile engine driving a 6½-ft propeller. It is set up on the edge of a 12-acre bog about 8 ft above the bog. It is mounted on a turntable so it can be rotated, but being placed on the side of the bog, it is naturally turned only through a small angle. It has been built with the idea of eventually being placed in the center of a bog where it can be turned in a circle.

We have made relatively few runs with the machine, but with a temperature inversion of 5 deg we have been able to raise the temperature on the bog from 4 to 5 deg to a distance of 300 ft. This would indicate that the machine will give considerable protection to a 6-acre bog. We shall need to obtain more information as to the amount of temperature inversion which can be expected at times of frost, but indications are that the use of blowers holds considerable promise for cranberry growers.

# New Developments in Small Electric Milk Pasteurizers

By D. E. Blandy and Maurice W. Nixon
MEMBER A.S.A.E. MEMBER A.S.A.E.

PASTEURIZATION of milk has been demonstrated to be such an important factor that health departments generally are raising the standards of milk quality, and requiring that more and more milk must be pasteurized before sale to the consuming public. Recent changes in the health regulations in New York state require that all milk sold in cities of 7500 or over must be pasteurized, certified, or special A raw. Thus many small dairymen who produce and distribute some 50 to 200 qt daily on retail milk routes in these smaller population centers, are affected. This situation has created a demand for small pasteurizers and processes which will fit their needs with respect to both the volume of milk produced and their incomes. Goats' milk producers are also demanding a small-capacity pasteurizer.

Recent investigations in New York include two closely correlated projects concerning small electric milk pasteurizers. One project, involving the development of a high-temperature, short-time or continuous-process method, was conducted at the Cornell University Agricultural experiment station. The other, concerning an in-the-bottle pasteurizer of the holding type, was conducted by the New York Power and Light Corporation and the New York State Department of Health.

With close coordination between regulatory authorities and scientific bodies, it would seem possible that devices could be developed, which would adequately meet the purposes for which they were intended, and at the same time satisfy the requirements prescribed by the health authorities.

Since much milk would probably be pasteurized by unskilled operators, it was important that processes should be simple, absolutely foolproof, and that the operator should have no control over temperature regulation or pasteurizing time. It seemed important to eliminate entirely any need for manual adjustments.

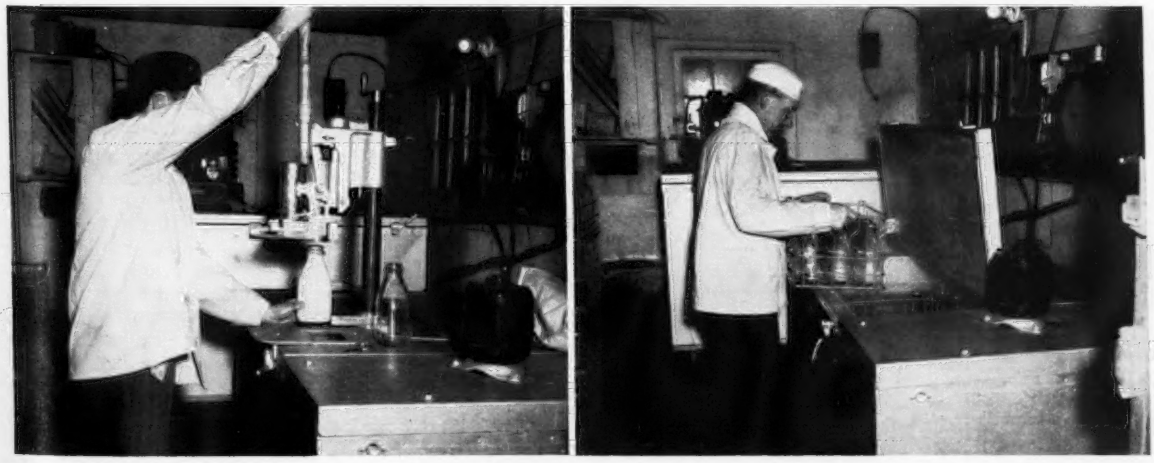
*The In-the-Bottle Pasteurizer.* The principle involved in this method consists of transferring heat as quickly as possible from a body of water held at 145 F (degrees Fahrenheit) to the bottled raw milk. The bottled milk is held in the vat for an hour and then cooled, still bottled.

About 15 years ago there were several types of in-the-bottle pasteurizers on the market, but since the milk was not pasteurized within the meaning of the official definition, and as it was possible for pathogenic organisms to survive the treatment, these were removed from plants and driven off the market. The basic difficulties were that (1) milk tended to stratify when heated in the common quart milk bottle right side up, (2) wooden milk bottle cases tended to insulate one tier from another, and (3) none provided proper circulation of an adequate volume of heating medium. These difficulties have been overcome through (1) the use of a new special, squat type, oversize, light-weight (16½ oz) milk bottle, (2) the use of welded steel-wire milk bottle crates, and (3) even circulation of a deluge of regulated hot water around the bottles.

The new equipment consists of a hot water tank with water pump, immersion type electric heaters and the necessary thermostats to control the temperature of the water bath, and indicating and a recording thermometer, and racks to support the bottle cases. It was necessary to use a new thin-wall, oversize glass milk bottle. Convection currents are set up in this bottle, making heating about twice as rapid as in the standard bottle. Bottle caps with paper inserts seal the bottle.

The heating period of about one-half hour is followed by a half-hour holding period, both of which are recorded on a graphic thermometer chart. After the milk has been

Authors: Respectively, rural service manager, New York Power and Light Corp., and rural service engineer, Empire State Gas and Electric Association.



(Left) Bottling milk in light-weight, oversize glass bottles. (Right) Placing bottles in pasteurizer. The bottles are submerged in circulating hot water. The cooling tank is in the background

held, the pump is stopped and the vat opened to remove the bottles in the wire crates. These are set in the air for five minutes or so, after which they are immersed in a cold circulating water bath and cooled to the desired temperature for storage. A milk cooler tank with special platform and pump was used for this purpose.

Two experimental units tested to date have capacities of four cases or 48 qt, and eight cases or 96 qt, respectively. A difference in the units is in the method of circulating the hot water. Both units have been tested, using thermocouples placed at the core of the milk in bottles located in various positions in the compartment and also placed in several positions in the same bottle. The tests show that all the milk reached 143 F or more within one-half hour. Samples from test runs showed proper pasteurization; a reduction in bacterial count to 99.7 per cent; the absence of coliform organisms in the pasteurized milk; and good flavor and cream line. The bottles and caps were also pasteurized, and there was no further exposure of the milk. One of these pasteurizers, installed on a dairy farm, has given satisfactory service for several months.

*The High-Temperature, Short-Time Pasteurizer.* In the design of a high-temperature, short-time or continuous-process pasteurizer, it was thought that if manual adjustments could be eliminated, all adjustable devices including temperature regulators, means of regulating the rate of water flow and the milk flow could be adjusted, tested and sealed by the department of health and these adjustments checked periodically by inspectors.

The hot-water circuit, milk circuit, and electric controls will be treated separately. The hot-water circuit consists of an electrically heated water storage tank, pump, booster, milk heater, and necessary piping. Hot water stored in the tank supplies much of the heat used in the pasteurizing process. As the hot water flows through the milk heater, a portion of its heat is given up to the milk, thus lowering the water temperature several degrees. To compensate for this reduction in temperature, a booster is inserted in the circuit ahead of the milk heater. This booster is designed to compensate for the difference in temperature of the water coming from the supply tank.

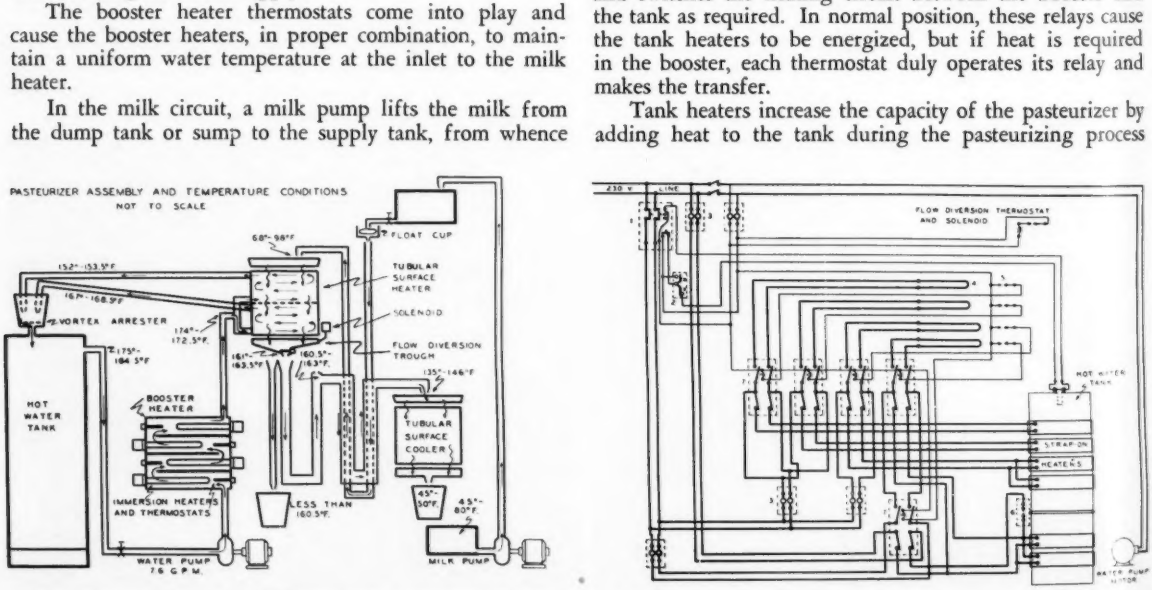
The booster heater thermostats come into play and cause the booster heaters, in proper combination, to maintain a uniform water temperature at the inlet to the milk heater.

In the milk circuit, a milk pump lifts the milk from the dump tank or sump to the supply tank, from whence it runs through an ordinary cream separator float cup, which combination of orifice and regulated head determines the rate of milk flow at slightly over one gallon per minute. The milk then runs through an inverted siphon and discharges into the distributing trough over the heater. Raw milk takes on some heat from the outgoing milk in this siphon, a part of which was built as a heat exchanger. Heat transferred depends upon the temperature of the raw milk, and ranges from 16 to 24 F as the raw milk temperature varies from 80 to 45 F. Raw milk flows down over the heater, where it becomes heated to the proper temperature, from 162 to 163 F. The heater used is a common two-stage tubular milk-cooler unit. The milk absorbs some 80 per cent of the necessary heat in the upper section and cools the water accordingly. The remaining 20 per cent of heat is added to the milk as it runs over the lower section. As the milk falls from the heater it is collected in a trough and then fed into a second inverted siphon serving as a holding chamber, through which the milk requires 15 sec to flow. After leaving the holder, the milk flows through a third inverted siphon which is built around the first, forming a heat exchanger. The milk is then discharged to be cooled for storage or bottling.

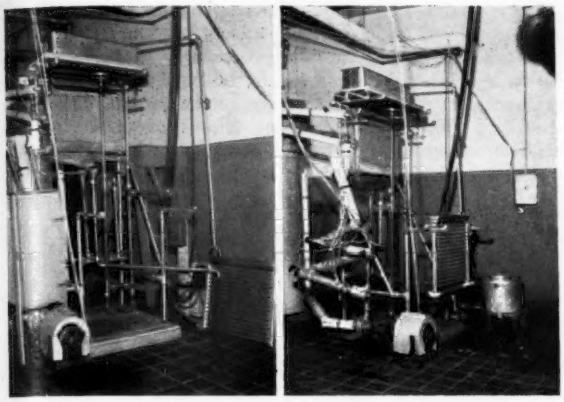
A thermostat in the collecting trough closes a contact, if and when the milk is above 161 F. The circuit thus closed energizes a solenoid which tips this trough to one side, allowing the milk to flow into the holder. When the milk is not hot enough the circuit is opened and the solenoid core drops to its normal position, causing the milk to flow into another pipe and back into the sump tank, thus insuring that underheated milk will not proceed as if it were pasteurized.

One electric circuit tapped off the supply line feeds the water pump motor; another feeds the standby heaters on the hot-water tank. The heater control circuit originates on the load side of the water pump switch, to insure that the booster heaters cannot operate unless the hot water is circulating. A thermostat in the hot water tank prevents overheating of the water. The main heating circuit is subdivided into four parts, each controlled by a thermostat in the booster. Each of these four thermostats operates a relay and switches the heating circuit between the booster and the tank as required. In normal position, these relays cause the tank heaters to be energized, but if heat is required in the booster, each thermostat duly operates its relay and makes the transfer.

Tank heaters increase the capacity of the pasteurizer by adding heat to the tank during the pasteurizing process




**(Left) Functional diagram of high-temperature pasteurizer. (Right) Wiring diagram: (1) Magnetic switch, (2) push button station, (3) fuse cut out, (4) immersion heaters, (5) booster thermostat, (6) standby thermostat, and (7) double-pole, double-throw relay**



Laboratory model of high-temperature, short-time pasteurizer, (left) with tubular cooler moved aside to show inverted siphons, and (right) with insulated box removed from booster heater. The hot water storage tank appears in the background at the left

when it is not required at the booster, and provide quick recuperation for an occasional excessive quantity of milk to be pasteurized. In addition, this arrangement maintains a constant electric demand during the time of pasteurization.

Booster heaters and their corresponding tank heaters are rated at 1, 2, 4, and 4 kw, respectively, from top to bottom in the booster, and indicated in the wiring diagram. If a slight amount of heat is necessary the 1 kw element comes on. If more is needed, the second heater is energized. The heat produced by this causes the first heater to cut out. Later, if more heat is necessary the first heater cuts back in, thus putting 3 kw in the booster. When more heat becomes necessary the third heater of 4 kw becomes energized, and since this supplies an excess of heat, 1 and 2 immediately turn off. The first two heaters come back again in the same order as before when 5, 6, and 7 kw are required. After this, the second 4-kw heater is energized, thus supplying 8 kw, at which time 1 and 2 cut out again, to be re-energized when necessary to supply 9, 10, and 11 kw at the booster.

In the experimental model the booster thermostats operated the relays directly. A method was worked out, although not applied to this pasteurizer, whereby the booster thermostats, as indicated, would close their respective relays while another thermostat at the outlet of the booster would open the relays when the water was heated sufficiently. Thus the booster thermostats would close their respective relays and hold them closed if the water temperature was below their setting, and the disconnecting thermostat would cause those relays to open where heat was unnecessary.

Figures in the functional diagram indicate the temperature conditions which were observed at various points during the operation of the pasteurizer, together with the temperature ranges during the process of pasteurization. The capacity of the pasteurizer, in terms of gallons of milk, is determined by the volume of water available, the temperature drop which may be compensated for in the booster heaters, and the temperature of the raw milk. Actually, with an 82-gal tank and the booster compensating for a temperature drop of 11.7 F, the capacity was 23 gal of 45 F milk and 60 gal of 82 F milk, with corresponding capacities for intermediate temperatures.

The temperature of the incoming milk made comparatively little difference, except as it affected the capacity of the pasteurizer. A range of 35 F in the temperature of the milk caused a variation of less than 3.6 F at the point of maximum heating. Thus the raw milk temperature is not a critical factor. Likewise, the rate of flow of hot water was not critical, but had a range over which satisfactory results were attained.

Two unfavorable conditions were found to arise by increasing the rate of flow of hot water. Capacity was greatly reduced because it was impossible to employ a considerable drop in hot water temperature. The booster heaters could not raise it many degrees. For example, with a 10-gpm hot water flow, we had a useful temperature range of less than 5.4 F. Milk began to cook on the heater quickly and to stick tenaciously, tending to insulate it. The lower limit of hot water flow seemed to be about 6.5 gpm and the optimum range some 7 to 8 gpm. The pasteurizer was adjusted to pump water at the rate of 7.6 gpm, at which flow a tank temperature drop of some 11.7 F could be employed. The milk cooking on the heater under these conditions was not enough to thermally insulate it and what did stick was easily removed by brushing off with cold water immediately after the run.

Procedure for operating the pasteurizer is simple. With the water supply in the storage tank approximately at the correct temperature, the operator starts the water pump to circulate the hot water, and then presses the button to turn on the automatic heaters. Within a few minutes the circulating water is at the maximum temperature and pasteurization starts. The operator then runs a gallon or two of hot water through the pasteurizer ahead of the milk, to wet all of the milk passages and to sterilize the equipment. The milk is started at once by pumping from the sump to the supply tank, from whence it displaces the water in the pipes, immediately following it through the pipes and over the heater, where it at once becomes heated to the proper degree. From this point the operator has no control over the operation of the pasteurizer but to see that milk is continuously supplied and removed as cooled.

Any break in the continuity of the milk supply is of minor importance if of only a few seconds duration. If the delay lasts for several minutes, the pump should be stopped and the milk heater rinsed with water to prevent evaporation of the milk and consequent cooking on. The pasteurizer should be started again as from the beginning, except that it is not necessary to wait for the hot water to be completely reheated.

Pasteurization will proceed until the capacity of the unit is exhausted, at which time the booster heaters will no longer maintain the proper hot water temperature. At this point the temperature will begin to fall, followed by a drop in the pasteurized milk temperature, which immediately affects the flow diversion thermostat, in turn causing the milk to bypass the holding chamber because it had not been heated sufficiently to insure proper pasteurization.

The size of the pasteurizer chosen should be adequate to handle the usual milk supply in a single run. If the milk supply is temporarily greater than usual, the extra milk may be pasteurized by the simple expedient of rinsing out the milk passages with cold water, operating the circulating pump and booster heaters for a few minutes to regain the heat lost from the water, after which time pasteurization can be continued by again starting as at first. The storage tank may be reheated in some 15 to 20 min.

At the conclusion of pasteurizing, the circulating pump should be shut off and cold water run through following the milk. This will reduce the temperature of the heaters and rinse off much of the milk that would otherwise have to be washed off later with more difficulty. When the circulating pump is shut off, the heaters are automatically

disconnected and the tank temperature will recuperate slowly by the automatically controlled standby heaters.

This pasteurization process did not impair the flavor of the milk. Phosphatase tests indicated satisfactory pasteurization. Cream volume at the end of 24 hr has been the same, whether milk was raw or pasteurized by either the conventional holder, or this high-temperature, short-time method. Bacteriological analyses indicate satisfactory killing of bacteria (90 to 99 per cent).

The electric consumption ran from ⅓ to slightly over ½ kwhr per gallon of milk pasteurized, plus standby tank losses.

There are several improvements in structural design which would have to be made, and could be easily supplied by equipment manufacturers. Among these are thermally-insulated sanitary heater covers, and the construction of the entire machine as a compact unit. The device must be built so as to be approved by health authorities. These requirements would not necessarily change the principles described. The high-temperature, short-time system of pasteurization appears to have certain advantages over the holding method, particularly in the line of ease of operation, and the fact that it does not require skill nor close attention to operate.

AUTHOR'S ACKNOWLEDGMENT: This paper was prepared in collaboration with W. D. Tiedeman, chief of the bureau of milk sanitation, New York State Department of Health; Dr. H. J. Brueckner, extension professor of dairy industry, Cornell University; and Simon Rottenberg, graduate student, Cornell University.

# Shrinkage of Artificially Dried Seed Corn

By R. H. Wileman
MEMBER A.S.A.E.

THE SHRINKAGE of seed corn in both weight and volume when artificially dried on the ear, is a problem of every seed corn producer. Since seed corn is of necessity harvested earlier in the season, than the regular corn crop to avoid freezing weather, the moisture content of both grain and cob are much higher than when harvested later. The relationship between grain moisture and cob moisture varies widely in this early harvested seed corn due to weather conditions and maturity of the crop. For these reasons moisture tables based primarily on corn as harvested for cribbing have been found to be very inaccurate when applied to seed corn harvested before freezing temperatures prevail and dried artificially on the ear.

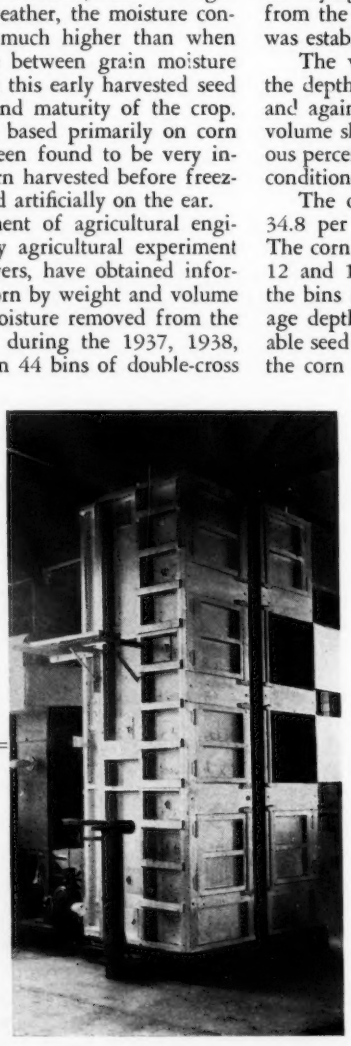
Studies made by the department of agricultural engineering of the Purdue University agricultural experiment station of bin type seed corn dryers, have obtained information on the shrinkage of ear corn by weight and volume as related to the percentage of moisture removed from the grain. These data were secured during the 1937, 1938, 1939, and 1940 drying seasons on 44 bins of double-cross hybrid seed corn. Ten Indiana hybrids of the 600 and 800 series are represented in these tests. The double-cross hybrid seed combinations included in these data represent nine single-cross combinations and eight inbred lines.

Three drying bins were used in this study each having a cross section 2x3 ft inside and a total height of 12 ft. These bins were mounted on platform scales (Fig. 1) so the weight of corn in the bin could be determined at any time. Thus by comparing the weight of moisture removed during the drying process with the percentage of moisture removed from the grain, the relationship between these two factors was established.

The volume shrinkage was determined by measuring the depth of the corn in the bin at the time drying began and again when it was finished. The average weight and volume shrinkage which resulted from the removal of various percentages of moisture from seed corn under the above conditions is shown in graph form in Fig. 2.

The corn used in these studies ranged from 14.8 to 34.8 per cent grain moisture when placed in the dryers. The corn was dried to a grain moisture content of between 12 and 14 per cent. The depth of corn when placed in the bins ranged from 5 ft 10 in to 8 ft 7 in, with an average depth of 7 ft 4 in. The corn was sorted and undesirable seed ears, husks and silks were removed before loading the corn in the drying bins.

Author: Assistant professor of agricultural engineering, Purdue University.



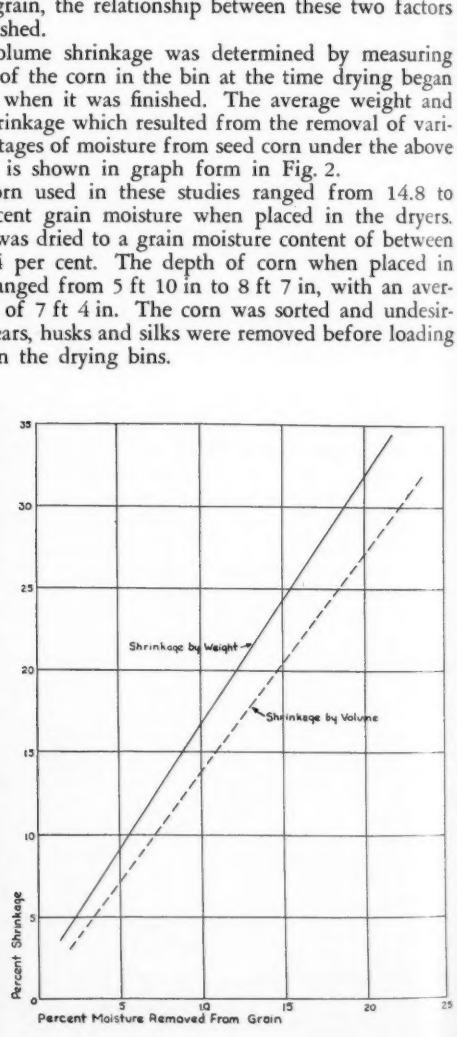



Fig. 1 (Left) Two of the drying bins used in the Purdue seed corn drying study. Each bin is mounted on a platform scale and is equipped with an individual fan for supplying air. Fig. 2 (Right) Graph showing the relation of weight and volume shrinkage of ear corn in relation to the per cent of moisture removed from the grain during artificial drying of seed corn on the ear

# Irrigation Pumping with Electric Power

By Aldert Molenaar
MEMBER A.S.A.E.

DEVELOPMENTS of the past few years in the extension of electric service into rural areas have created a genuine interest on the part of farmers in pumping irrigation water with electric power. On REA-financed systems, in areas where pumping for irrigation is practiced or has potentialities of development, stories of a dependable and, particularly, an economical source of power for pumping often even preceded the earliest attempts at design of the distribution systems. In some instances farmers refused to sign contracts for domestic service unless they were assured that power for the operation of their irrigation pumps would also be made available.

From the standpoint of an agency selling and distributing electricity, an irrigation load is often not a particularly desirable load. Even under most favorable conditions, it is a seasonal load. The requirements of only a moderately sized irrigation load will place unusually heavy demands upon the distribution facilities for a comparatively short period of the year. This situation particularly affects the limited facilities of small distributing agencies such as REA-financed cooperatives. To these cooperatives the apparent advantages of an irrigation load are often nullified by the additional expenditures necessary to make the service available.

Bringing electric service to an area for irrigation pumping requires special design and construction of the distribution system. Unless the pumps to be served are few and small, three-phase construction is a necessity. Since irrigation pumps, in even the more developed areas, are generally spaced considerable distances apart, the expenditures involved for making irrigation service available are high. Great efforts have been put forth, with a marked degree of success, to lower cost of distribution system construction. However, even with the most optimistic estimates of possible reductions in the cost of construction of lines and facilities, the expenditures per pump will still be high. Therefore, when electricity does become available, the rates that need to be charged for irrigation service are usually higher than expected by the farmers to whose attention have come stories of low generating costs and low wholesale rates. The expenditures involved in the heavier and often special construction of lines and increased generating and substation capacities required to accommodate the load are of necessity reflected in the retail rates to the farmers for irrigation service.

Usually pumping for irrigation has been well established long before electricity becomes available to an area. Existing pumps were installed to be operated with tractors or stationary types of internal-combustion engines. Most of these pumps were designed for slow speed and operated by means of belt drives. In the installation of many of the pumps little or no consideration had been given to operating efficiency, with the result that the power requirements usually were excessively high.

Early attempts at serving irrigation loads have failed in several instances because of the lack of appreciation for the need of adapting irrigation pumping to electric power. Tractors and stationary engines again replaced electric motors. The usual reason for the failure to accept electric power was explained by the fact that the cost for service was prohibitive. However, in a great many of these cases the excessive cost of operation was not due so much to the cost of electricity as to the inefficiency of the equipment. Pumps were poorly fitted and badly worn, belt and other indirect drives accounted for appreciable losses, and motors often were too heavily overloaded for satisfactory operation. Instead of replacing the inefficient, poorly adapted pumping plant with a properly fitted and efficiently performing plant designed for operation with an electric motor, the motor was put aside and the old engine put back into service.

Realizing that efficiently performing equipment is a prime requisite to the lasting success of an irrigation load, the REA developed a policy designed to guide the system personnel as well as the members of the systems in the proper adaptation of irrigation pumping to electricity. This policy is based on the principles that should be observed in the installation of any pumping plant, namely, testing the well to determine its characteristics, fitting and installing the type and size of equipment in accordance with the characteristics of the well and the needs of the irrigator, and making an acceptance test following installation to determine whether or not the installation and performance are in accordance with specifications and guarantees.

Although we were convinced that suitable equipment was the key to satisfaction in the use of electricity for irrigation pumping, the farmers had to be shown the necessity of parting with the pumps that had satisfactorily, though perhaps not efficiently, served them in the past. All they had expected to buy was a motor. In some instances our efforts at guidance were not appreciated and the farmers decided that a cheaper installation or fixing up of the existing pump would adequately serve the purpose. Numerous cases of this type could be cited, but a few of the outstanding examples will suffice.

Last season a farmer in the Sulphur Springs Valley of Arizona made arrangements to have a horizontal motor belted to a centrifugal pump already installed in the well. The pump was located at the bottom of a 30-ft, unlined pit, and the motor was installed to operate the pump through a direct drive. When the installation had been completed it was found that the water in the well pulled down to a level approaching the practical suction lift in the area. A test on the unit indicated an overall efficiency of 22 per cent.

The farmer decided then to make a change and install a turbine type of pump. Still not willing to follow recommendations, he made a deal with the pump representative to use some of the pipe and materials he already had on hand. Instead of putting a strainer of approved design on the suction pipe, a small saving was effected by taking a length of the available used pipe to the blacksmith shop where the opening at the lower end was closed off and long slots cut in the sides with a torch. These slots were to serve as the strainer openings. A recent test on this unit showed an overall efficiency of 42 per cent. Analysis of the trouble indicated that trash or a piece of stone or wood might have lodged in the impellers of the pump, thus

A paper presented before the Rural Electric Division at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. Author: Agricultural engineer, Rural Electrification Administration, U. S. Department of Agriculture.

reducing the capacity of the pump considerably below that for which it was designed and installed. This farmer has spent a considerable sum of money and still does not have a satisfactory installation.

Another example of the lack of conviction that suitable and efficiently performing equipment is essential to successful operation of irrigation pumps with electric power was the case of a farmer on the Texas plains, who bought himself a rewound 40-hp horizontal motor to be connected to the geared head of the turbine pump already installed in his well. When installed it was found by actual tests that the load on the motor was 52 hp and the overall efficiency 38 per cent. Naturally the man complained about the high cost of electricity for pumping and today is operating again with an engine.

Then there was the case of the farmer at Kearney, Nebraska, who insisted that he could not afford to install the type of equipment recommended for successful operation. This man was operating six wells, three of which were located rather closely together. A transformer bank was placed centrally between these three wells and secondary line run to each of them. A 15-hp, rewound motor was acquired and made portable by placing it on a car chassis. It was the intention to move this motor from well to well as the need for water on the crops to be irrigated with each of the pumps arose. Soon after the motor was belted to the first of the pumps, a locally made turbine pump, an efficiency test was made which showed an overall efficiency of 34 per cent.

The motor was never moved to either of the other two wells. A tractor was used to do most of the pumping during the remainder of that (1939) season. Early in 1940 this same man sold his portable motor and installed new unit-drive turbine pumps in four of his six wells. Nearly all of his irrigating is now done with water pumped by the four electrically operated units.

The examples referred to above might tend to leave the impression that all pumps in operation in wells before the coming of electricity were poor pumps. It should be understood that such is not the case. With but few exceptions, the fact that the pump had never been properly fitted to conditions under which it was to operate, rather than the mechanical and hydraulic characteristics of the pump, accounts for the greater part of the poor showing.

On a recent trip through the Sulphur Springs Valley of Arizona I had occasion to run a test on a newly installed unit that appeared to have the characteristics necessary for satisfactory operation with electric power. The motor and pump met the requirements of structural specifications, but performance was very bad. Back in 1934, a large turbine pump, designed to deliver 1000 gpm, was installed in the well. This pump did not perform satisfactorily because the capacity of the well was not great enough.

When the time came to change over to electric motor drive, it was decided that the large pump should be removed and a more suitable unit installed. An attempt at testing the well showed that a capacity of 300 gpm was all that the well would sustain. The farmer would not abide by the results of the test and insisted that the well would produce considerably more water. Against the recommendations of the representative of the pump company, too large a pump was installed. This pump has now been in operation for several months, alternately pumping water and air; for about 10 sec it delivers the 600 gpm for which it was designed. Then the water level in the well reaches the lower end of the suction pipe and the flow of water through the pump is disrupted. After 30 to 40 seconds the water again rises sufficiently to cover the impellers and the pump again delivers a pipe full for a few seconds. Since the installation was completely unsatisfactory, no attempt was made to estimate the average rate of discharge from the pump.

The installation of equipment adapted to electrical operation brings up a question of how much a farmer can afford to pay for pumping equipment. Assuming that the pumping of irrigation water is *(Continued on page 260)*

Fig. 1 Three-phase power bank for irrigation pumping service. Fig. 2 Horizontal centrifugal pump. Fig. 3 Vertical centrifugal pump. Fig. 4 Irrigation pump, once operated by electric motor, again run by tractor. Fig. 5 The old and the new. In the background the old, one-cylinder engine; in the foreground a unit-drive, water-lubricated pump in an artesian well. Fig. 6 Unit-drive turbine pump installation over open pit. Replaces centrifugal pump from bottom of pit. Fig. 7 Approved type of electrically driven irrigation pump installation, protected by combination overload, low-voltage and short-circuit controls. Fig. 8 Electrically operated pump lifting 1,000 gpm from 30 ft below the ground surface with a 10-hp motor

# One-Can Electric Milk Coolers

By John E. Nicholas
MEMBER A.S.A.E.

THE latest addition in the farm electric milk cooling field was the development of a one-can milk cooler. A survey in the state as well as that in the United States had disclosed the fact that approximately 50 per cent of the dairy farmers produce less than two cans of milk per day. On the basis of this survey, it was suggested that a one-can milk cooler would meet the full requirements of these producers. Several manufacturers, after some consideration, have undertaken to develop and build such a cooler.

*Physical Characteristics.* The complete milk cooler consists of the cabinet and the condensing unit located at the side or on top of the cabinet. Some designs have the evaporating coil an integral part of the condensing unit and is generally known as the "drop-in" type; others have the evaporating coil on the outer side of the inner shell. This is said to have certain advantages, such as safety to the evaporating coil from damage during loading and ease of cleaning. The cabinet is just large enough to accommodate a 10-gal can at one cooling. The water to milk ratio of 3.5 was available in the cooler discussed in this paper, which was of the "drop-in" type.

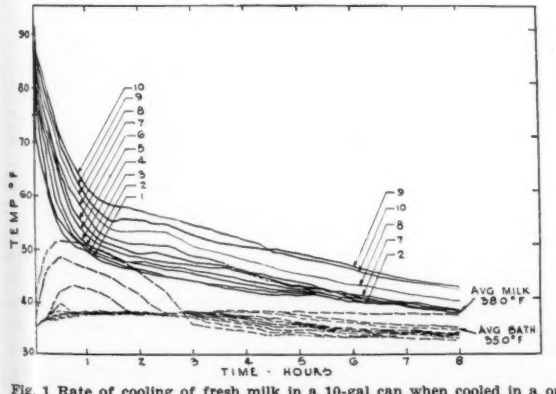
*Laboratory Tests.* The laboratory tests consisted of determining (1) the 21-day heat loss test, (2) the temperature gradient of milk in a can under thermostatically controlled operating conditions of the unit as designed, with and without agitation of the water bath, and (3) a ten-day loading test to determine the cost of operation in kilowatt-hours per 10-gal can when cooling two cans in 24 hr with the unit loaded twice a day—cooling one can in the morning and one in the evening.

*Method of Determining Heat Loss.* The unit was connected to a 110-volt (a-c) line, through a standard house type kilowatt-hour meter, and a rotating standard. Both measured the energy consumption at desired intervals. The cabinet, filled with 44 gal of water, brought the water level to a height of 20½ in, measured from the floor of the cabinet. The unit was then put into operation, cooling the water to the temperature set and maintained by the thermostat. During the initial cooling of the water, an ice bank approximately ¾ in thick formed on the coil. The thickness of the ice could be increased or decreased by varying the distance between the sensitive bulb of the thermostat and the evaporating coil. Nearly ten days of automatic operation were allowed to establish the operating equilibrium.

The heat loss test was made in a room temperature of approximately 75 F (degrees Fahrenheit), and the water bath was found to be at an average temperature of 34 F. At the termination of the heat loss test the water was immediately removed, and the ice bank remaining on the coil was left to melt. By weighing the meltage, the size of the ice bank was found to be 33 lb.

*Temperature Gradient in Milk.* In the milk cooling tests the cabinet was filled with 35 gal of water, with a full 10-gal can placed in the cabinet; the unit was then allowed to reach the operating equilibrium as controlled by the thermostat. Approximately the same size ice bank formed on the coil as in the heat loss tests. The temperature gradient test consisted in cooling a 10-gal can of fresh milk without agitation of the water bath with the water-to-milk ratio equal to 3.5. Fig. 1 shows the temperature of the milk at ten different points during its cooling for eight hours. The stratification in the water bath the first three hours shows that the water was not in motion. The top layer of the water bath reached a temperature of over 51.6 F in the first half-hour. The bottom of the milk in the can at the end of the first hour was 49.7 F, and the top of the milk was 61 F. The ice bank on the evaporating coil, although available initially, does not become effective until the third hour of cooling. The dotted lines in Fig. 1 show the temperature stratification in the water bath. The top water layer reached 51.6 F at the end of the first half-hour, the layer 2 in lower was 48.1, and the next lower layer, a temperature of 42.2 F. The remaining body of the water bath was approximately at the same temperature at that interval. Fig. 1 also shows that when the upper layer of the water bath around the neck of the can reaches the maximum density of 39.6 F, an inversion takes place, the colder water on top which accelerates the cooling of the milk in the can. At the end of eight hours of cooling, the

Authorized for first publication in AGRICULTURAL ENGINEERING, May 21, 1941, as paper No. 1032 in the Journal Series of the Pennsylvania Agricultural Experiment Station. Author: Professor of agricultural engineering, The Pennsylvania State College.



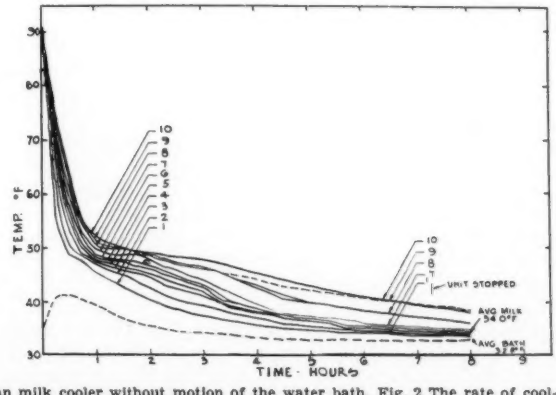




Fig. 1 Rate of cooling of fresh milk in a 10-gal can when cooled in a one-can milk cooler without motion of the water bath. Fig. 2 The rate of cooling of fresh milk in a 10-gal can when cooled in a one-can milk cooler with motion of the water bath

average temperature of the milk was 38 F and that of the bath was 35 F.

*Cooling with Agitation.* Fig. 2 shows the temperature gradient in a can of fresh milk cooled under similar conditions as that shown in Fig. 1, except that the bath water was now in motion. The motion of the water was obtained by immersing a ¾-in diameter propeller which was operated by a small 60-watt electric motor. The motion of the water was not turbulent, but was sufficiently agitated to stir the water bath, maintaining it at a uniform temperature. The rate of cooling of the milk in the can as shown by the ten thermocouples is more rapid than in the previous test, and the temperature differential at the end of the first hour of cooling is also smaller, with the top of the milk at 51.9 F and the bottom of the milk at 45.4 F, which is 6.5 deg difference in temperature. At the end of an 8-hr period of cooling, the final average temperature of the milk was 34 F, while that of the water bath was 32.8 F. The milk cooled 4 deg more, in an equal interval, than in a test in which there was no motion to the water bath.

*A 10-Day Loading Test.* A 10-day test was made to obtain the energy in kilowatt-hours required to cool a 10-gal can of milk. The cabinet was loaded twice a day—in the afternoon at 4:45 p.m. and in the morning between 8:00 and 8:45 a.m. Table 1 shows the results of the 10-day test on the cost of operation. The data consists of the temperature of the water bath at each loading, the initial and final temperature of each cooling load, the meter readings, and the energy consumption per load cooled.

TABLE 1. TEN-DAY TEST ON THE COST OF OPERATION OF ONE-CAN MILK COOLER

| | | Energy—Recorded by | | Bath | Temp of load, | |
|---|---|---|---|---|---|---|
| | | Rapid | | temp | stirred, avg deg F | |
| Date | Time | meter, whr | Std kwhr | stirred, deg F | Initial | Final |
| Apr 1 | 8:30 a.m. | | | 35.0 | 91.0 | |
| Apr 1 | 4:45 p.m. | 1616.96 | 1.64 | 35.0 | 91.0 | 36.0 |
| Apr 2 | 8:15 a.m. | 1255.04 | 1.25 | 35.0 | 90.5 | 35.0 |
| Apr 2 | 4:45 p.m. | 1636.26 | 1.62 | 35.0 | 91.0 | 36.0 |
| Apr 3 | 8:15 a.m. | 1238.18 | 1.26 | 35.0 | 92.0 | 35.0 |
| Apr 3 | 4:45 p.m. | 1698.68 | 1.71 | 35.0 | 90.5 | 36.0 |
| Apr 4 | 8:30 a.m. | 1196.68 | 1.19 | 35.0 | 91.0 | 35.0 |
| Apr 4 | 4:45 p.m. | 1622.22 | 1.61 | 35.0 | 90.0 | 36.0 |
| Apr 5 | 8:15 a.m. | 1205.78 | 1.21 | 35.0 | 90.0 | 35.0 |
| Apr 5 | 4:45 p.m. | 1666.00 | 1.65 | 35.0 | 91.0 | 36.0 |
| Apr 6 | 8:15 a.m. | 1226.00 | 1.23 | 35.0 | 90.0 | 35.0 |
| Apr 6 | 4:45 p.m. | 1652.02 | 1.63 | 35.0 | 91.0 | 36.0 |
| Apr 7 | 8:15 a.m. | 1300.00 | 1.29 | 35.0 | 91.0 | 35.0 |
| Apr 7 | 4:15 p.m. | 1620.24 | 1.62 | 35.0 | 91.0 | 36.0 |
| Apr 8 | 8:15 a.m. | 1310.70 | 1.32 | 35.0 | 90.0 | 35.0 |
| Apr 8 | 4:45 p.m. | 1581.30 | 1.58 | 35.0 | 91.0 | 36.0 |
| Apr 9 | 8:15 a.m. | 1311.74 | 1.31 | 35.0 | 90.0 | 35.0 |
| Apr 9 | 4:45 p.m. | 1624.26 | 1.63 | 35.0 | 90.5 | 36.0 |
| Apr 10 | 8:00 a.m. | 1277.76 | 1.26 | 35.0 | 91.0 | 35.0 |
| Apr 10 | 4:45 p.m. | 1690.18 | 1.70 | 34.5 | 90.0 | 35.5 |
| Apr 11 | 8:15 a.m. | 1315.80 | 1.33 | 34.0 | | 34.2 |
| | Averages | 1452.29 | 1.45 | 34.9 | 90.6 | 35.4 |

The method of determining the energy consumption was made by using warm water as a substitute for the milk load. In all cases the temperature of the 10 gal of water was not lower than 90 F, and the temperature of the water bath as determined after a vigorous stirring and before placing of load was on the average of 35 F. When the cooling load was removed in the morning or in the evening, its temperature was obtained after a vigorous stirring of the water in the can. The morning load remained in the cabinet for approximately 8½ hr while the evening load cooled for 15½ hr. The final temperature of both the evening and morning load was the same. The total time of operation for both loads was approximately a total of 8 hr every 24. The minimum energy consumption was 1.06 kw-hr for the morning load on April 1, and the maximum energy consumed was 1.71 kw-hr during the cooling of the evening load on April 3. The average energy consumption of a 10-day test was, per 10-gal can of cooling load, 1.45 kw-hr. This is equivalent to approximately 2.6 watthours per gallon degree of useful cooling.

SUMMARY

1 The cost of maintaining the water bath at an average temperature of 35 F for 21 consecutive days was approximately 1.02 kw-hr per day.

2 The temperature gradient in milk when cooled without agitation of the water bath is shown in Fig. 1.

3 The available refrigeration in the form of ice bank on the coil does not become effective until after the third hour (Fig. 1). The water bath stratifies with a temperature difference of nearly 15 deg in an 8-in layer measured from the top of the water bath (Fig. 1).

4 When the water bath is in motion, the milk cools more uniformly in the first hour, as shown in Fig. 2, and there is no stratification in the water bath.

5 The temperature difference between top and bottom of the milk in the can is less when the milk is cooled by agitation of the water bath (Fig. 2).

6 The effect of agitation reduced the final temperature of the milk 4 deg lower at the end of 8 hr of cooling (Figs. 1 and 2). The cost of operation in a 10-day test was 1.45 kw-hr per 10-gal can. This is equivalent to approximately 2.6 watthours of electrical energy expended per gallon-degree of useful load cooled.

## Irrigation Pumping with Electric Power

*(Continued from page 258)*

an economic feasibility in any particular area, the question resolves itself into a determination of whether the additional cost involved in replacing existing with more suitable equipment can be justified. It can be readily shown that the operating cost rather than the first cost of the equipment constitutes the principal item of expense in connection with irrigation pumping. This being the case, it is very desirable that equipment be installed which is fitted to operating conditions, adapted to electric motor drive, and designed and built to deliver the desired quantity of water as economically as possible.

As an aid to enable farmers to install the equipment necessary to operate their irrigation pumps with electric power, REA started about two years ago an irrigation equipment financing plan. Though originally designed to build load on the distribution systems, this financing plan became most effective as a means of getting efficiently performing pumping equipment connected to the lines. The required down payment was made attractively small, the duration of the loan was made over a six-year period, and interest rates were reasonable.

However, equipment to be considered for financing had to be in accordance with structural and performance specifications prepared by REA. This provision actually slowed down the connection of pumps to the lines of the systems for the first season of operation. After that enough of the farmers had been convinced that suitable, efficiently performing equipment was essential to satisfactory operation with electric power, and connection of pumps proceeded more rapidly and on a permanent basis.

The results of our efforts to guide the farmers in the proper adaptation of irrigation pumping to electric power materialized slowly but steadily. At the end of the first season of operation only nine of the 23 pumps connected to the lines of the Buffalo County, Nebraska, Public Power District might have been considered properly suited to electrical operation. At present this system is serving 200 pumps, in its third season of operation. Fully 90 per cent of these pumps meet what I consider the essentials necessary to satisfactory operation with electric power.

# The Test of Terracing Practices

By Earl L. Arnold
JUNIOR MEMBER A.S.A.E.

THERE is an old saying, "You can take the boy off of the farm, but you can't take the farm off of the boy." I imagine that most of us in this group were reared on farms. We have all probably had considerable experience with many types of farm operations. We are known as agricultural engineers. This implies a sufficient familiarity with farming to be able to make practical application of sound engineering principles to farming practices. Yet, I am often inclined to believe that our engineering is better than our agriculture in some of the recommendations that we make and in some of our practices.

I firmly believe that the ultimate test of any of our recommendations lies in the way they work out in actual farming practice. The best recommendation in the world is absolutely worthless unless farmers are able to and actually do follow it.

Terracing is now rather well accepted by farmers as a desirable means of controlling erosion. In fact, some experts on erosion control believe that farmers are oversold. Other erosion control measures are not so well accepted. I think we are agreed that terraces, if they are to be most effective, must be accompanied by contour farming.

During the past few years I have made a particular point of observing terraced fields as I have traveled along highways. The amazing thing to me has been that in many areas there is almost a total absence of contour farming on these terraced fields. This is true in spite of the fact that the recommendations of all educational agencies require that terraces be accompanied by contour farming. In other areas I have observed that a large share of the terraced fields are farmed on the contour. What is the cause of this difference? Let us analyze what we are suggesting that the farmer do in his farming operations.

In certain areas most of the slopes are regular and even. Terraces on such land are relatively straight, or they have long, gentle curves. In other areas slopes are mostly irregular and uneven. Conventional terraces on such land are exceedingly crooked, and the spacing between them varies greatly at different places in the field. If my observation is correct, it is in the latter situation where we find farmers failing to practice contour farming with their terraces.

I have often wondered how many farmers try contour farming with their terraces for a year or two and then abandon the practice. One day last summer, while traveling with an engineer of the Soil Conservation Service over a portion of one of the old soil conservation projects, this was brought forcibly to my attention. It was an area of irregular, uneven slopes. Very few of the farmers were farming on the contour with their terraces, but the thing that impressed me was the large number of cases where the engineer made statements such as this: "That field was terraced in 1937. The farmer farmed on the contour in 1938, but has not done it since." We stopped at one farm and found the farmer working in his corn field. The field was terraced and the terraces were apparently in good condition. The corn rows ran with the terraces. We asked the farmer about the field, and he told us that part of the field had been terraced in 1924 and the rest of it in 1925. Since that time the field had been continually plowed and tilled on the contour. But the surprising thing was that the farmer said that this was the last year that he was going to continue the practice, because it took too much time and was therefore too expensive. He said that in 1941 he was going to plow with the edge of the field. He was going to attempt to maintain his terraces, but he was going to do it by other means.

When we find a farmer who has followed our recommendation for 16 years and says that this is the last year, we should examine the recommendation! If 16 years of practice has not convinced a practical farmer that we are right, I doubt the value of the recommendation.

For fear of being misunderstood, I want to state that I am convinced that there are areas where farming on the contour with conventional terraces is practical. My discussion here refers particularly to those areas where farmers have tried the practice and abandoned it, and where they have refused to adopt it.

These irregular, uneven slopes are not usually found in the most prosperous agricultural areas. Any increase in the cost of farming operations may be the difference between a profit and loss. Following these exceedingly crooked terraces may easily increase the cost of farming to the point where the farmer cannot afford it.

There has been considerable discussion in agricultural engineering circles regarding the relative value of the ridge type and the channel type of terrace. I believe the channel type has largely won the argument. The question has been decided almost entirely on the basis of checking the flow of water down the slope. Not enough consideration has been given to the effect on farming operations.

In Arkansas we are generally recommending a channel type terrace from 18 to 20 ft wide with a difference in elevation between the bottom of the channel and the top of the ridge of about 18 in. These terraces do not digress far from the contour lines. Is there any good reason why, when one of these terraces has been laid out, we should not go back over the terrace line and straighten it considerably? Wherever the terrace curves around a high place, we might use the channel type of terrace. Where the terrace curves around a low place, we might use the ridge type. Across the low places the terrace might be entirely ridge and across high places entirely channel. By following this procedure we could make the terrace straight, so long as the differences in elevation on the straight line were not more than 18 in. If the differences were greater than this, we would still have to give some curve to terraces, but we could make them much straighter than we are now doing. I believe that those who teach terracing in our schools generally recommend smoothing out the sharper curves. I am suggesting that we not only smooth out these curves, but that we eliminate them, in so far as we can within the limitations of terrace height, by using a combination ridge and channel type terrace. I suggest this not for its desirability as an engineering feature in the control of erosion, but as a recognition of good farming practice.

I believe that this type of terrace would work as satisfactorily as those we are now using. It would be a little harder to build, but on irregular slopes would make farming with the terraces simpler, and I believe that more farmers would farm with them.

A paper presented before a meeting of the Southwest Section of the American Society of Agricultural Engineers at Dallas, Tex., April 1941.
Author: Extension agricultural engineer, University of Arkansas.

# A Flood Control and Water Conservation Project

By W. L. Powers
MEMBER A.S.A.E.

THE primary object of the multipurposed Willamette Basin Project in Oregon is protection of the area against floods and to conserve the excess water for beneficial use as an aid to development of navigation, power, irrigation, reduction of stream bank erosion, and of stream pollution. Major construction features include seven storage reservoirs, locks, open river improvement, and fish facilities, at a total estimated cost of $62,070,000. The seven proposed reservoirs would have a total capacity of 1,345,000 acre-feet, the surface areas of which would total 26,800 acres, or more than a township collectively.

These reservoirs are referred to as the "initial development". The ultimate "coordination plan" contemplates raising three dams in the interest of power development.

In operating the reservoirs, it is planned they would be emptied in the late autumn and caused to partly fill only as necessary to equalize runoff. Storages would be filled in early spring and release made from about July first in the interest of navigation and irrigation. Annual cost of operation is estimated to approximate benefits and is to be borne by the federal government. Only agricultural benefits from the project will be considered briefly here.

The project is needed to provide a correlated program of land and water use in this major Oregon valley with its problems of excess winter moisture alternated with dry late summers and its possibilities for supporting a very large population and developing a more intensive agriculture, particularly on the valley floor and rich bottom lands.

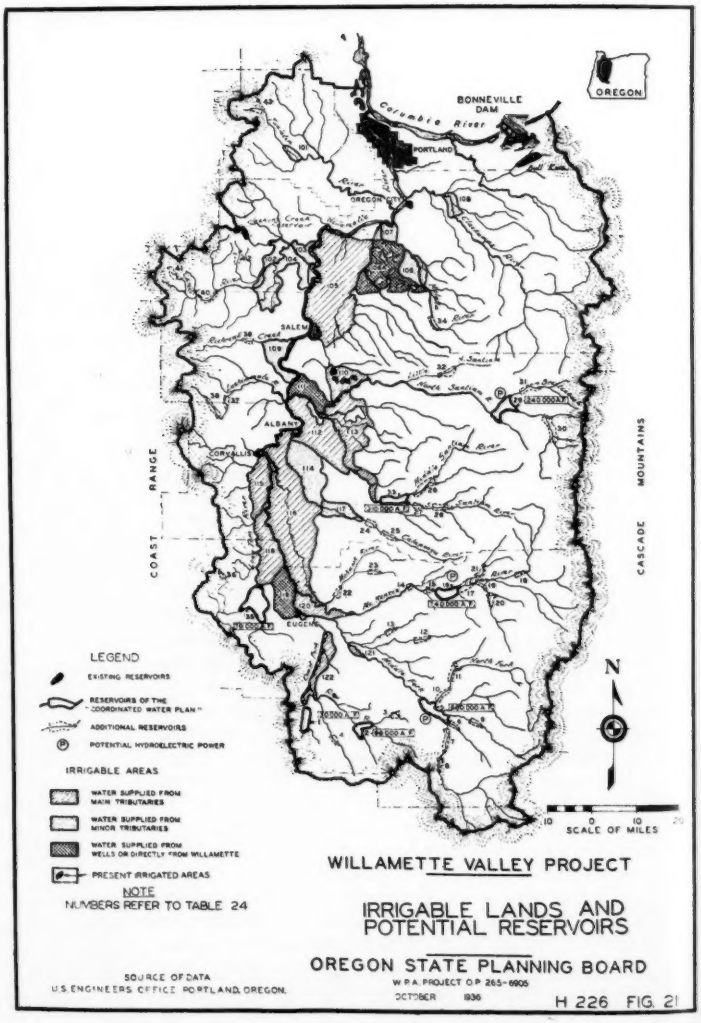
Irrigation with stored flood water and the maintenance of a higher level of ground water due to release during the summer months will create many hundreds of farm opportunities through both gravity and pump irrigation. This will help provide a wider range and a major supply of high-quality food to meet requirements for the rapidly growing Pacific Coast region.

Good irrigable soil types in the valley total 740,000 acres, while additional types of fair irrigability increase the total irrigable area to around 1,200,000 acres. Any substantial development in this way will depend upon stored water. The project could supply gravity water to 224,000 acres of this favorable land and increase the ground water level for pumping to a similar additional area.

Increased production of forage, dairying products, and other livestock enterprises, as well as new opportunities in fiber flax, vegetables and seed crops, commercial vegetable production, hops, mint and other oil crops, sugar beets for seed and for sugar, drug plants, and other specialty crops, which are largely dependent on an expansion of irrigation in the Willamette Valley, will add not only to productive land values, but to the total agricultural and business returns of the area.

The control of Willamette Valley floods will save much valuable land by preventing stream bank and surface erosion. Storage will eliminate flood hazard which records show to be a farm problem from the middle of November until late March. Preventing these winter floods will permit farmers to grow certain fall-planted crops not now safe because of overflow hazard and will allow for winter and early spring land preparation and for earlier planting than can be safely contemplated under present conditions.

Control of wild floods will prevent frequent infestation of farm lands with noxious *(Continued on page 265)*




First publication in AGRICULTURAL ENGINEERING as technical paper No. 318 of the Oregon Agricultural Experiment Station, with the approval of the Director and as a contribution of the soils department. Author: Head, department of soils, Oregon Agricultural Experiment Station.

# Hydraulic Head Measurements in Soils with High Water Tables

By R. E. Moore and Kenneth R. Goodwin
MEMBER A.S.A.E.

PREVENTION of the accumulation of excess salts in the soil or the amelioration of areas affected by alkali is accomplished by leaching. The possibility of leaching depends upon the permeability of the soil and upon the hydraulic head and gradient of the ground water. Adequate leaching is impossible if the water table is high, or if the hydraulic gradient within the normal root zone is upward. To improve either of these situations, the water table must be lowered and the hydraulic gradient reversed. This is generally accomplished by the installation of artificial drainage.

The design of land drainage systems is facilitated by information relative to the magnitude of hydraulic heads and gradients below the surface and to the depth, dip, and thickness of the aquifers and other strata which comprise the upper 20 or more feet of the earth's profile. This information is basic to the solution of such problems in drainage design as tracing the troublesome water to its source or to the place at which it can be intercepted most practicably; selection of the system of drainage to be used, such as drainage by pumping, tile or open channel drains, or some combination of these with vertical drains; determination of which stratum or strata to tap in order to secure the desired water table and hydraulic gradients with the least expenditure in drainage installation, operation, and maintenance.

With the exception of some areas for which there are many years of drainage experience, there is only fragmentary and uncoordinated data available upon which to base a drainage design, such as supplied by test wells, well logs, and shallow surface borings. This paper describes portable equipment and its application to the study of the groundwater hydrology and stratigraphy of drainage situations.

*Apparatus.* The apparatus consists of a soil probe, an adjustable mercury manometer calibrated to read hydraulic head in feet of water, a hydraulic jack to force the probe into the soil, and a fabricated steel tower anchored to the earth. The tower acts as a guide for the probe, supports the jack and manometer, and takes the reaction of the jack.

The probe (Fig. 1) is assembled to any desired length from 5-ft sections of steel tubing of $1\frac{1}{8}$-in outer diameter and $\frac{1}{2}$-in inner diameter. The tubes are coupled by screw threads and made watertight at each joint by rubber gaskets. A point containing a porous cell closes the lower end of the probe, and a pushing cap with a pressure tubing connection to the manometer closes the upper end. The porous cell is a section of an alundum extraction thimble of medium porosity, 1 in in diameter and 11/16 in long.

The tower (Figs. 2 and 3), is 7 ft high and fabricated from 4-in steel channels weighing 5.25 lb per ft, placed face to face, which form the way for the jack and probe guides. It is anchored to the earth with four or more pole line anchors. The anchors used are of the two-way expansion type which are set at depths of from 3 to 4 ft in a 6-in auger hole and then expanded to $14\frac{1}{2}$ in. Each of these anchors is capable of resisting ten-

Authors: Respectively, irrigation and drainage engineer, and agent, Regional Salinity Laboratory (Riverside, Calif.), Bureau of Plant Industry, U. S. Department of Agriculture.

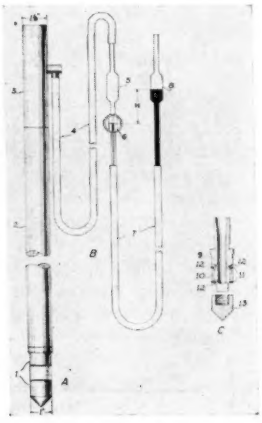
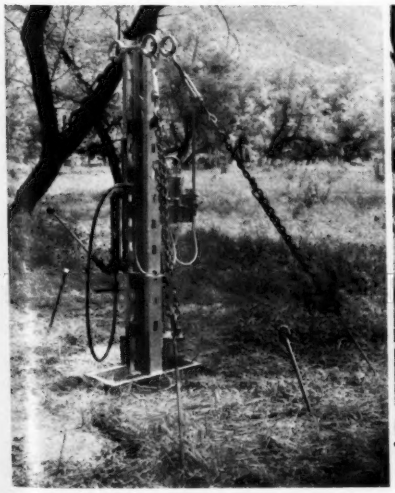


Fig. 1 The soil probe assembled, A; the manometer, B; and details of the probe point, C. The details are (1) the probe point containing a porous cell, (2) a probe tube which may be assembled to any desired length by adding additional sections, (3) a pushing cap, (4) flexible tubing connection from the probe to the manometer, (5) the fixed side of the manometer showing the capillary tubing and mercury meniscus magnified at (6), (7) flexible tubing connecting the fixed and movable bulb of the manometer, (8) manometer bulb mounted on a scale which is adjustable vertically and calibrated to read hydraulic head in feet of water, (9) upper segment of probe point, (10) porous ceramic cell, (11) synthetic rubber gaskets, (12) holes connecting the annular space between the cell and the upper segment of the point with the inside of the probe, and (13) hardened point. The system is completely filled with water between 1 and 6. As the probe is forced into the earth, changes of water pressure at 1 are transmitted to 6. These changes are balanced by adjusting 8 vertically



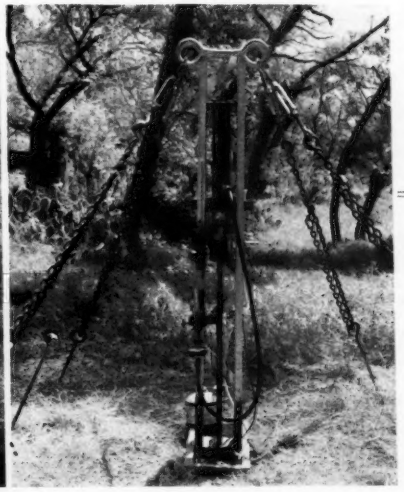


Fig. 2 (Left) Portable equipment set up to force the probe into the earth. The manometer mounted on the back of the tower is connected to the probe by flexible tubing. The hydraulic pump is mounted on the face of the tower and the hydraulic ram between the leads. Fig. 3 (Right) A front view of the setup shown in Fig. 2, but equipped for pulling with a pulling cap on the probe and a bridle on the ram

sion stresses varying from two to five tons. The maximum pressure required to force the probe to a depth of 45 ft in the soils we have explored is 12 tons, with an average of approximately 9 tons.

One side of the manometer is fixed in position and is connected to the probe by rubber tubing. The other side of the manometer is a leveling bulb mounted on a scale which is adjustable vertically by means of a rack and pinion. This bulb is open to the atmosphere and is connected to the fixed side of the manometer by rubber tubing. The manometer is used as a null instrument, the mercury meniscus on the fixed side being held to a horizontal line on a glass capillary tube by raising or lowering the leveling bulb. The hydraulic head is read on the scale in feet of water above or below the ground surface.

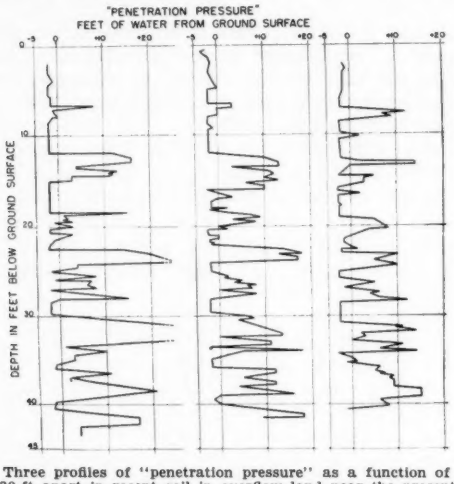



Fig. 4 Three profiles of "penetration pressure" as a function of depth, taken 30 ft apart in recent soil in overflow land near the present channel of the San Jacinto River, 3 mi east of Casa Loma

*Operation.* The probe and its connections are completely filled with water from the porous cell to the manometer. The manometer scale is set to read zero-head when the water table is at ground level. The probe is then forced into the soil at an approximately constant rate of 4 in per min and hydraulic head readings are plotted as a function of the depth of the cell below the ground surface. A party of three men can complete one exploration of 45 ft of soil profile in one working day.

Soil and water are displaced by the probe as it penetrates the soil, temporarily increasing the pressure in the soil water surrounding the cell. We have called these induced pressures "penetration pressures" to distinguish them from the equilibrium pressures reported as hydraulic head. The magnitude of a "penetration pressure" is related to the nature of the stratum penetrated and the rate of penetration and will vary from zero in coarse sand to hydraulic heads of 20 ft and greater in clay.

Soil profiles were explored in recent outwash soils along the San Jacinto River in California. Penetration pressure and hydraulic heads for these profiles are plotted as functions of depth in Figs. 4 and 6. The soils in this region are highly stratified with alternating strata and lenses in a wide variety of textures. The penetration pressures reveal this stratified condition, attaining various positive values through strata of intermediate to low permeability and dropping precipitately when sand strata are encountered.

Equilibrium readings of hydraulic head are taken in the strata of high permeability at elevations immediately below that in which a precipitate drop in penetration pressure occurs. Jacking is stopped for these readings and equilibrium is attained within a few minutes, whereas it may require from one to 24 hr for the head to become steady in strata with high penetration pressures.

Three holes 30 ft apart were put down to test the reliability of penetration pressures as criteria of stratification. If abrupt changes in penetration pressures are taken as indicating changes in soil character, the penetration pressure profiles of Fig. 4 may be interpreted to indicate the stratification diagramed in Fig. 5. The results indicate that this probe is a tool of high sensitivity for determining the stratigraphy of unconsolidated sediments below the water table.

*Application of Probe to Engineering Problems.* Many applications of hydraulic head and stratigraphic information to such investigations as land and highway drainage, foundations and borrow pit sites, and small domestic or irrigation water supplies are apparent. We have planned investigations which we believe will result in an extension of its use. These include hydraulic head measurements and core sampling for the purpose of correlating penetration pressure with soil permeability, and subsurface sampling for quality of water.

## SUMMARY

Portable apparatus consisting of a soil probe, a mechanism to force the probe into the earth, and a device to measure the hydraulic head at the probe point is described.

Information on the hydrology and stratigraphy of unconsolidated soil sediments below the water table may be derived with this apparatus, and application of this information to engineering investigations are discussed.

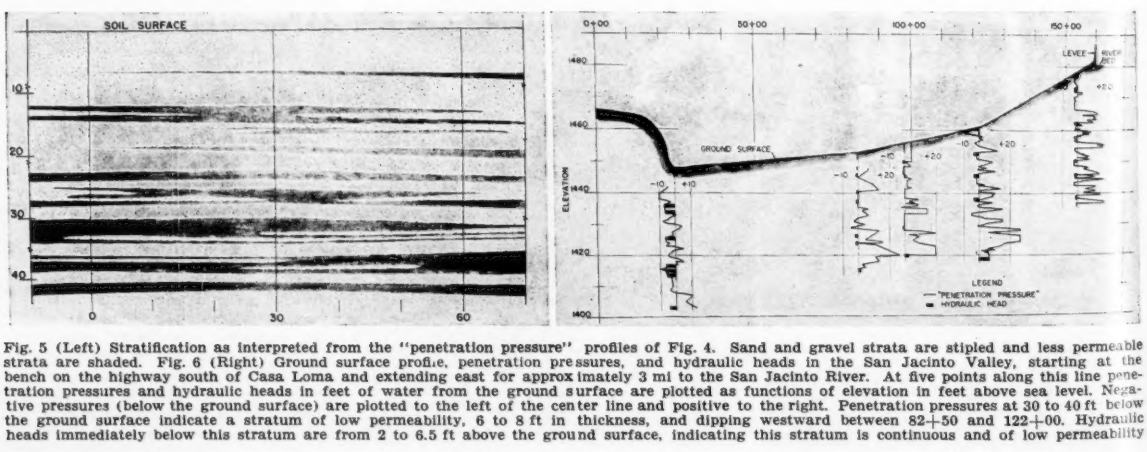



Fig. 5 (Left) Stratification as interpreted from the "penetration pressure" profiles of Fig. 4. Sand and gravel strata are stipled and less permeable strata are shaded. Fig. 6 (Right) Ground surface profile, penetration pressures, and hydraulic heads in the San Jacinto Valley, starting at the bench on the highway south of Casa Loma and extending east for approximately 3 mi to the San Jacinto River. At five points along this line penetration pressures and hydraulic heads in feet of water from the ground surface are plotted as functions of elevation in feet above sea level. Negative pressures (below the ground surface) are plotted to the left of the center line and positive to the right. Penetration pressures at 30 to 40 ft below the ground surface indicate a stratum of low permeability, 6 to 8 ft in thickness, and dipping westward between 82+50 and 122+00. Hydraulic heads immediately below this stratum are from 2 to 6.5 ft above the ground surface, indicating this stratum is continuous and of low permeability

# Flaxseed Production Problems in the Southwest

By E. S. McFadden

FLAX production in Texas has grown from a few experimental rod-rows on the experiment stations of South Texas in 1937 to about 29,000 acres in 1940. The greater part of the acreage is grown on the coastal prairie between Wharton and Kingsville and in the lower Rio Grande Valley where it is grown principally under irrigation.

The flax crop in Texas is grown for the seed only, since there is no market for the straw in Texas at the present time due to there being no processing plants for handling the straw in the vicinity of the fields. The seed, due to its less bulky nature, can be economically transported to the linseed oil mills in the northern states and the Atlantic seaboard or processed locally by the cottonseed oil mills with minor alterations in their equipment.

Flaxseed yields in South Texas have been averaging between 10 and 12 bu per acre, which is nearly double the average yields obtained in some of the old producing areas in the North. Prices for the seed usually run between $1.50 and $2.00 per bushel, or approximately double the price of wheat.

It is in the more humid part of the coastal prairie lying between Wharton and Port Lavaca that the greatest production problems are encountered. Most of the problems that still remain unsolved are of a mechanical nature. These are concerned principally with the harvesting and storing of the seed.

In the old flaxseed producing regions, flax is usually harvested with the same machinery that is used for harvesting other small grains.

In the greater part of the flaxseed producing area of the Texas coastal prairie where small grains are not grown, the windrow pick-up method is rapidly becoming the standard method of harvesting. The small combines used in harvesting grain sorghums in that area are fairly satisfactory for the harvesting of flax after minor adjustments have been made. However, the tooth type of cylinder which is in general use in threshing flax in the spring wheat area is not entirely satisfactory in South Texas due to the high relative humidity, which toughens the seed bolls or pods, and results in a tendency for the cylinder teeth to strip the bolls off without crushing them and releasing the seed. This tendency is further aggravated under South Texas conditions by the necessity of growing varieties with thick-walled, nondehiscent bolls for protecting the seed against moisture. These varieties are proving to be something like David Harum's horse that was guaranteed to "stand without hitching". They stand too well to be threshed with the ordinary cylinder type of thresher. Unbroken bolls pass over the screens and into the tailings, whence they are returned to the cylinder for a second threshing. But while passing through the return elevator they come into direct contact with green stems, leaves, and other material that is high in moisture content, from which they absorb additional moisture which makes them harder to thresh than they were the first time they passed through the cylinder. Consequently many of the same bolls are returned to the cylinder again and again before they are finally broken and the seeds released. This often results in congestion and ultimate clogging of the return elevator. The rasp-bar type of cylinder is somewhat more effective than the tooth type, but it also leaves many of the bolls unbroken.

A recent invention which partly solves this problem is an attachment consisting of a set of rubber rollers, or of one rubber and one steel roller. The crop passes through these rollers just before it reaches the cylinder, and the greater part of the bolls are crushed upon passing between the rollers. Furthermore, the rollers have a slight retarding effect which aids the cylinder in threshing out the seed.

Possibly the only additional equipment required to do a perfect job of pick-up threshing of flax under ordinary conditions prevailing in South Texas, is a second set of smaller rollers to crush the unbroken bolls that find their way into the tailings. This second rolling could be done either before the tailings enter the return elevator or just before the tailings re-enter the cylinder.

Another important accessory for threshing flax to be stored in a humid climate, such as that found in the Texas coastal prairie, is a seed re-cleaner mounted on the thresher, that will remove the greater part of the moisture-bearing foreign material such as green stems, leaves, and weed seeds before the flaxseed absorbs much of the moisture. It is essential that flaxseed shall not contain much moisture when put into storage. Ordinarily the seed from combined flax is sufficiently dry for storage if it were not for the presence of moisture-bearing foreign material in the seed. By removing this foreign material from the seed before it leaves the threshing machine, one of the biggest storage problems would be solved.

A paper presented before a meeting of the Southwest Section of the American Society of Agricultural Engineers at Dallas, Tex., April 12, 1941. Author: Associate agronomist, U. S. Department of Agriculture.

## A Flood Control and Water Conservation Project

*(Continued from page 262)*

weeds, the seed and roots of which are carried by flood water. Loss of livestock by drowning will be eliminated, also the damage done to farm improvements, orchards, berry plantings, hop yards, and the country roads by floating debris.

Cost of reservoirs and their maintenance is to be paid for by the federal government under the flood control act of 1938. Construction of Fern Ridge dam is nearing completion and the Cottage Grove dam is well under way.

The U. S. Bureau of Reclamation is making a study of irrigation possibilities and has made preliminary examination of 22 possible irrigation projects. More intensive study is being made by this agency of the East Long Tom due to availability of Fern Ridge reservoir water, the Yamhill basin, and the Tualatin basin. A land classification as to irrigability is being completed on aerial photographs. Soil, topography, drainage, vegetation, irrigation, water requirement, and land-use capabilities are taken into account. A survey of principal canals is to follow. Studies of water supply, plans, estimates, and economic feasibility are under way and maps are in preparation. The area has state representation in the form of the Willamette Basin Commission created by legislative act.

# Farm Building Service for the Southwest

By Deane G. Carter
FELLOW A.S.A.E.

DEMAND for farm building service in the Southwest is far greater than the capacity of the colleges of agriculture for rendering such service. This is the most significant fact concerning farm buildings in the Southwest.

In the west south central area there are about 1,240,000 occupied farm dwellings, or nearly 17 per cent of all farm dwellings in the United States. The region has one of the largest broiler producing areas in the whole country. The crop adjustment programs have resulted in enormous increases in feed and forage and emphasis on beef production. State health departments are insisting on more adequate facilities for dairying. Sweet potato curing and storage is a strictly southern problem. The availability of WPA labor, and a lack of funds for extensive public works has stimulated the construction of hundreds of sales barns, fairgrounds buildings, community centers, and similar structures in rural areas.

These conditions have resulted in a constant and vigorous demand for assistance. Yet in the west south central area, consisting of the states of Arkansas, Louisiana, Oklahoma, and Texas, there is probably no one person in the state agricultural experiment stations or the state agricultural extension services who is devoting full time to farm buildings. In a recent mimeographed statement, the American Society of Agricultural Engineers notes that "at present less than one-fourth of the states devote the equivalent of one man's full time to agricultural extension work with farmers or with county agents on farm buildings problems. . . . Very little of the personal aid essential in planning can be given by this skeleton force."

Some idea of the farmer demand for aid in planning may be gained by the experience at the University of Arkansas. A series of articles in a southern farm journal, together with brief announcements of available plans, resulted in orders for more than 9,000 blueprint sheets in 1940. At present the plan orders are exceeding 200 sheets per week from this single source. More than 15,000 blueprints were distributed altogether in 1940. One article published by the Associated Press brought 400 letters of inquiry, although the address of the university was not given in the story. A three-column article on the inside pages of the April issue of a national magazine brought 1373 inquiries up to April 1. There is a day-to-day demand for plans, information, and service that cannot be answered in an adequate way, because of the lack of personnel.

The resources for handling the farm buildings work are extremely limited, not only in personnel, but in funds, illustrative material, and planning aids. Although each state has some material, in the form of blueprint plans, plan lists, mimeographed material and the like, the capacity for rendering service is strictly limited. The publication of U.S.D.A. Farmers' Bulletin 1738, "Farmhouse Planning", the Midwest Farm Building Plan Service catalog, and U.S.D.A. Miscellaneous Publication 360 have been valuable and helpful. Yet they do not solve the plan service problem for the Southwest but serve to emphasize the deficiencies in our capacity to render essential service. For example, it is not consistent for us to offer northern plans or eastern plans for the solution of many of the farm buildings problems of the Southwest.

The very origin of the regional plan services tends to hinder their purpose. The books were made up of the time-tested, "favorite" plans of a dozen states. Thus the plans presented are among the older designs—the more conventional buildings—and they tend to "fix" plan and design, that may or may not be the most appropriate for the time and place where the plans are to be used.

Granted that the available planning services are the best we have, many of the plans may be criticized as being old, formal, unattractive, often uneconomical, and so far as we are concerned in the Southwest, not adapted to the climate, topography, farm incomes, and farm needs of the region.

Since farm dwellings constitute the largest group of buildings in the Southwest, and the needs for improvement are the most immediate, it may be worth while to examine the conditions and needs somewhat in detail. The federal housing survey data for the west south central region reveals the following average facts about farm housing: The size, 4.2 rooms; occupancy, 4.6 persons per house; condition of crowding, 1.1 persons per room; and more than 2 persons per sleeping room. The index of house structural condition was 33 (out of 100, perfect score). Facilities included clothes closets, 34.3 per cent; bathrooms, 11.3 per cent; flush toilets, 3.6 per cent; kitchen sinks, 10.9 per cent.

These are the elementary facts about the housing condition: In comparison the average condition is less satisfactory than in any other geographic division; only the east south central is closely comparable.

There are, of course, sound reasons to explain this relatively low rank in housing quality. The proportion of owners to tenants is approximately 40:60; and tenant-occupied houses everywhere average lower than owner-occupied houses. About one-fourth of the farmers are colored; again this denotes a relatively low average condition of housing. The income per farm is low, and the region has a large number of farms that are barely self-sufficing.

It is significant to note that about 60 per cent of the farm dwellings are less than 25 years old (compared to 45 per cent for the nation). The index of condition is 33 (compared to 44 for the whole country). Just 2.5 per cent of the houses were built of stone, logs, or earth construction.

This low level of housing exists in an area where labor is plentiful; industrial occupations do not absorb the surplus labor; and wages are low. The region has the greatest pine producing area; abundant hardwood timber; and rocks, sand, and gravel are obtainable in almost every section.

The condition of farm service buildings is quite comparable to the condition of dwellings, and in general the same solution may be applied for improvement.

The preliminary census reports for 1940 indicate a decline of farm building values by about 17 per cent from

A paper presented before a meeting of the Southwest Section of the American Society of Agricultural Engineers at Dallas, Tex., April 11, 1941. Research Paper No. 696, Journal Series, University of Arkansas, approved by the director of the Arkansas Agricultural Experiment Station. Author: Professor and head of the agricultural engineering department, University of Arkansas.

the 1930 level. This is not due altogether to changes in appraisal. The depression and adjustment years have accelerated the decline in building values. There is considerable evidence to indicate that farm structures are at the lowest point in many years.

The whole picture, however, is not too dark. The evidence of interest on the part of the farm public is encouraging.

A number of farm leaders are concerned about the problem. On March 5, Senator Caraway introduced a bill in the United States Senate providing for appropriations for extension service aid in housing and building, beginning at one million dollars, and increasing to 5 million in 5 years; one million dollars a year for research; and some $265,000 annually for instruction. This bill or some similar provision for affording more adequate service should solve the greatest problem.

Provision for a more simple method of financing is also a paramount need. Although the Federal Housing Administration, the Farm Security Administration, and the federal land banks are constituted to serve in financing, the needs of the small farmer are by no means satisfied. Arrangements would be desirable that would enable a farmer of good standing to borrow $250 to $750, as a character loan, to be repaid within 10 years or less.

The procedure that appears to be the most effective, under present conditions, is a program that emphasizes cost reduction by (1) reduction in materials cost by the use of native, local, unprocessed, or low-value materials, and (2) reduction in labor cost by the use of farm and family labor and low wage labor for building.

These methods, combined with the best available planning service, and such aid as the extension agents can render, will be productive of important farm building improvements.

In conclusion, a four-point program in farm buildings is suggested for consideration by the Southwest Section of the American Society of Agricultural Engineers:

1 Emphasis on the need for more farm building specialists, and more technical training in housing and building for agricultural workers.

2 Continue efforts toward farm building improvement, with available facilities, by stressing plans, home-labor, native materials, and technical aid where possible.

3 Endorse the bill now before the U. S. Senate for research and extension work in farm buildings.

4 Begin efforts to develop a plan service handbook for the southwestern states.

## A Poultry Ventilation Problem

ADVERSE atmospheric conditions as related to inadequate ventilation in indoor-hen-battery plants is responsible for mortality often ranging from 40 to 60 per cent. Mortality occurs as the result of the development of paralysis, leukemia, and emaciation. A definite syndrome involving molting, irregular egg clutch, and poor development accompanies mortality and its intensity is in direct proportion to the rate of mortality. Inadequate ventilation of indoor battery broiler and fryer plants is reflected in lowered resistance to infection, reduced growth rate, poor feathering and lack of uniform growth; mortality under these conditions often occurs in case ventilation is grossly inadequate. The time factor is important in the development of paralysis, leukemia, and emaciation in hen batteries inadequately ventilated; mortality from these manifestations does not begin to occur until the birds are 5 months of age or thereafter. There is a rather definite biologic saturation point as related to density of population for each battery plant. The installation of adequate ventilation corrects adverse atmospheric conditions in battery plants and reduces mortality and other ill effects to a minimum.—*Abstract of a paper by M. W. Emmel, Florida Agricultural Experiment Station, before the 1941 A.S.A.E. annual meeting.*

# NEWS

## A.S.A.E. Meetings Calendar

Sept. 29-Oct. 1—North Atlantic Section, Jackson's Mills, W. Va.

December 1-3—Fall Meeting, Stevens Hotel, Chicago.

June 22-25—Annual Meeting, Hotel Schroeder, Milwaukee.

## Grain Storage Research Coordinated

ACCORDING to a recent report of a meeting at Ames, Iowa, April 4, representatives of state colleges and experiment stations of the Middle West, and of interested federal agencies, reviewed corn and wheat storage problems by way of reorienting, planning, and perfecting the coordination of further research in phases of the work involving agricultural engineering, entomology, plant pathology, animal nutrition, and agricultural adjustment.

Dr. H. J. Barre was named chairman of a contact committee in which each of these interests is represented, to facilitate the spread of information between members of each group, and between the related groups.

Other A.S.A.E. members who attended the meeting were Wallace Ashby, Dr. J. B. Davidson, F. C. Fenton, Kirk Fox, Thomas E. Long, I. D. Mayer, C. K. Otis, C. H. VanVlack, and R. H. Wileman.

## S.A.E. Tractor Meeting

THE Society of Automotive Engineers announces that its national tractor meeting, an annual event, will be held at the Schroeder Hotel, Milwaukee, Wis., September 25 and 26.

## Nominations Invited for 1942 A.S.A.E. Medal Awards

IN ACCORD with the rules governing the award of the John Deere and Cyrus Hall McCormick gold medals, the Jury of Awards of the American Society of Agricultural Engineers will receive from members of the Society, up to October 1, nominations of candidates for these two awards for the year 1942.

Members of the Society nominating candidates for either award are requested to keep in mind the purposes of each medal and formulate their nominations accordingly. The John Deere medal is awarded for "distinguished achievement in the application of science and art to the soil," which citation is interpreted to cover more than a mechanistic concept of engineering, and to include chemistry, physics, biology, and any other science and art involving the soil, the "application" being acceptable to "evaluation by the engineering criteria of practicality and economic advantage."

The Cyrus Hall McCormick medal is awarded "for exceptional and meritorious achievements of a continuing career or to any single item of engineering achievement, and to apply equally to all special fields and types of engineering in agriculture."

The Jury of Awards desires that members of the Society consider it their duty and obligation to give serious thought to the matter and nominate for either or each of these awards the men they believe to be most worthy of the honor. Each nomination must be accompanied by a statement of the reasons for nominating the candidate and the qualifications of the nominee, including his training, experience, contributions to the field of agriculture, a bibliography of his published writings, and any further information which might be useful to the Jury in its deliberations.

The Jury will accept and consider nominations received on or before October 1, and these nominations should be addressed directly to the Secretary of the Society at Saint Joseph, Michigan. The Secretary will be glad to supply on request a standard set of instructions for preparing information in support of nominees for the Society's gold medal awards.

Additional information on the history, significance, and description of these medals will be found in AGRICULTURAL ENGINEERING for May 1932 (McCormick medal) and October 1937 (Deere medal).

## Personals

*Harry E. Besley* is senior author of New Jersey Agricultural Experiment Station Bulletin 689, on "Development of Machinery for Harvesting and Storing Grass Silage."

*Henry Giese,* professor of agricultural engineering, Iowa State College and *Charles T. Bridgman,* research fellow, Iowa State College, 1934-35 (and now regional director, Structural Clay Products Institute), are joint authors of Research Bulletin No. 286, entitled "Precast Tile Beam Floor," issued by the Iowa Agricultural Experiment Station, May 1941.

*Otto E. Griessel* was recently transferred to the Washington office of the U. S. Soil Conservation Service, where he is assistant mechanical engineer in the service operations division. Previously he was junior agricultural engineer in the Service at Marshall, Mo.

*W. V. Hukill* is one of the authors of "Calorimetric Measurements of the Heat of Respiration of Fruits and Vegetables," published as U.S.D.A. Technical Bulletin No. 771.

*C. F. Kelly* reports on "Temperatures of Wheat in Experimental Farm-Type Storages," in U.S.D.A. Circular No. 587.

*George A. Randel* is now employed as junior soil conservationist at the Cherryville, North Carolina, soil conservation camp of the U. S. Soil Conservation Service. He was formerly employed in the production control department of the Cessna Aircraft Corporation.

## Applicants for Membership

**The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the June issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.**

*William F. Ackerman,* assistant instructor, agricultural engineering department, Pennsylvania State College, State College, Pa.

*J. C. P. Agnew,* Starr, S. C.

*Chester O. Anderson,* junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) SCS-11, Blair, Nebr.

*Joel M. Babb,* Gray Court, S. C.

*Aurelius P. Barnett,* junior agricultural engineer, Southern Piedmont Experiment Station, Watkinsville, Georgia. (Mail) 297 Hull Street, Athens.

*Juan Bazo-Fontaneil,* 315 North 18th St., Corvallis, Ore.

*T. Gill Blakeney,* junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 582, Bowie, Texas.

*Leonard W. Bonhorst,* designing engineer, New Method Equipment Co., Indianola, Iowa.

*Charles R. Boone,* farmer, Grafton, N. D.

*Wendell L. Clarke,* 2211 Ross Ave., Waco, Texas.

*John Ernest Cottingham, Jr.,* RR No. 1, Dillon, S. C.

*Earle F. Cox,* Allis-Chalmers Mfg. Co. (Mail) 7031 Saint James St., Wauwatosa, Wis.

*Joseph J. Crane,* extension service, University of Tennessee, Knoxville, Tenn. (Mail) 2018 W. Cumberland.

*Emile W. Daniel, Jr.,* RFD, Claxton, Ga.

*Edwin L. Dottery,* junior engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 1428 Prince Ave., Athens, Ga.

*Julius O. Doty,* RR No. 3, Hillsboro, Ohio.

*Brantford G. Elliott,* junior engineer, Allis-Chalmers Mfg. Co., LaPorte, Ind. (Mail) 210 B St.

*Bertis L. Embry,* junior engineer trainee, Rural Electrification Administration, U. S. Department of Agriculture. (Mail) 221 Holly Ave., Takoma Park, Md.

*Orville C. Hansen,* junior irrigation engineer, Farm Security Administration, U. S. Department of Agriculture. (Mail) 1541 S. 25th St., Lincoln, Nebr.

*Paul E. Harbison,* junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Johnson, Kans.

*George M. Hardy,* junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 935 Russell St., Augusta, Ga.

*Winston H. Hedges,* junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Bridgeport, Nebr.

*Milo W. Hoisveen,* project engineer, Farm Security Administration, U. S. Department of Agriculture. (Mail) Hay Springs, Nebr.

*John W. Holliday,* trainee, Goodyear Tire and Rubber Co. (Mail) Lexington, Ga.

*R. Bruce Hopkins,* tractor division, Allis-Chalmers Mfg. Co. (Mail) 1141 S. 76th St., West Allis, Wis.

*A. Clark Hudson,* architectural designer, Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture. (Mail) 115 Milledge Heights, Athens, Ga.

*James T. Hudson,* 115 Milledge Terrace, Athens, Ga.

*Donald W. Kruse,* junior soil conservationist, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Weeping Water, Nebr.

*Ray L. Lien,* junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Camp SCE-CCC 6, Fort Meade, S. D.

*Robert M. Magee,* John Deere Wagon Works. (Mail) 1856 17th Ave., Moline, Ill.

*John W. Marquardt,* executive secretary and consulting electrical engineer, State Rural Electrification Committee, 220 Centennial Bldg., Springfield, Ill.

*Elmer L. McKesson,* soil conservationist, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 303 E. Claremont St., W.H., Petersburg, Va.

*Richard E. Melson,* executive training course, International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.

*Linn G. Melvin,* 404 S. 5th St., Champaign, Ill.

*E. L. Miller,* RR No. 2, Lebanon, Ohio.

*Leonard Miller,* agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 6th and Duffield, Hebron, Nebr.

*Ernest L. Munter,* tractor engineer, Allis-Chalmers Mfg. Co., Milwaukee, Wis. (Mail) 529 N. 67th St.

*Joseph C. Newell,* Hemingway, S. C.

*Albert E. Powell,* graduate student, Dairy Research Station, Sussex, N. J.

*Glenn Herron Reynolds,* Albany, Tex.

*Paul R. Rist,* junior agricultural aide, Soil Conservation Service, U. S. Department of Agriculture. (Mail) SCS-Iowa 29, Box 323, Oskaloosa, Iowa.

*Earl J. Rodman,* Rodman, S. C.

*Charles L. Seal,* draftsman, H. B. Gieb & Associates, 206-7 Bernhardt Bldg., Monroe, La.

*Sam Shiozawa,* trainee, Rural Electrification Administration, U. S. Department of Agriculture. (Mail) 1708 New Hampshire Ave., N.W., Washington, D. C.

*Lavern R. Sorensen,* John Deere Tractor Co. (Mail) RR No. 2, Nevada, Iowa.

*Robert L. Stenburg,* junior engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) RR No. 1, Tremonton, Utah.

*Wilfred J. Stuart,* RR No. 2, Lexington, Nebr.

*Lawrence R. Swarner,* U. S. Bureau of Plant Industry, Medford Experiment Station, Medford, Ore. (Mail) Box 426.

*Douglas M. Warriner,* president, Warriner Starch Co., Inc., Box 115, St. Francisville, La.

*Charles C. Worstell,* John Deere Tractor Co., Waterloo, Iowa. (Mail) 320 Dunham Place.

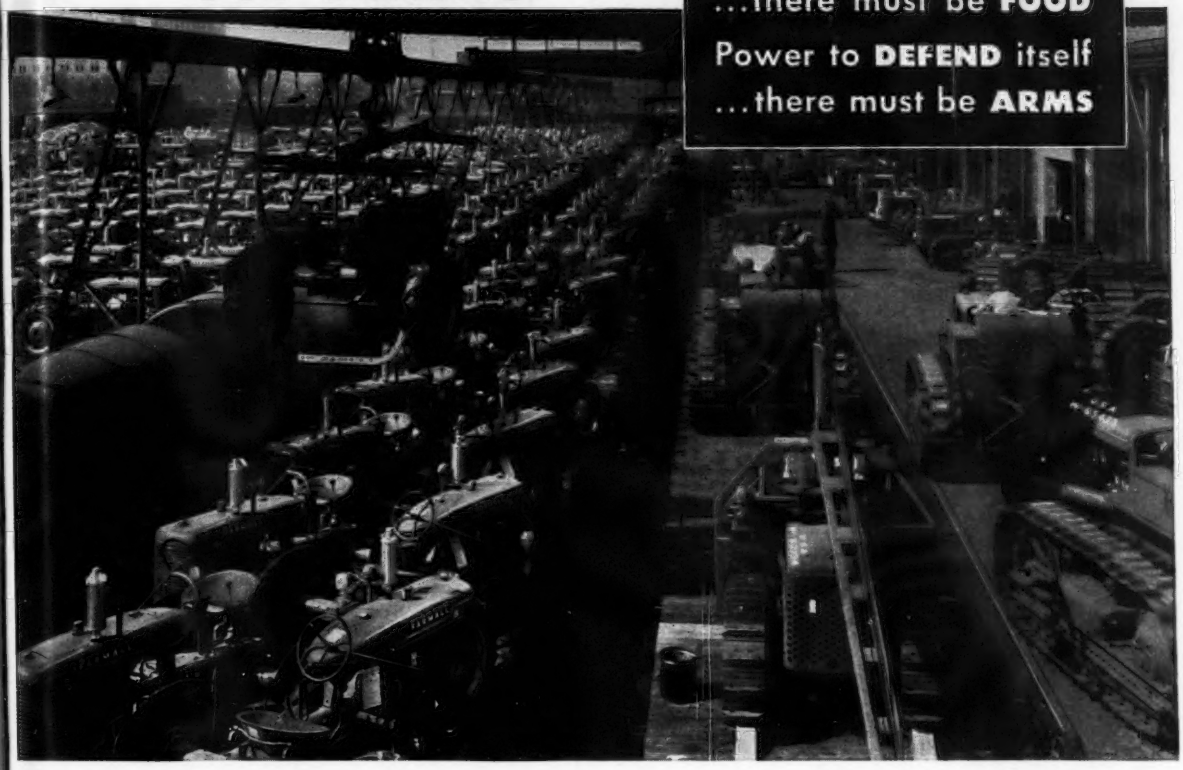
*Orville W. Zastrow,* 304, Kronshage Dormitories, Madison, Wis.

# PRODUCTION! for FOOD... for ARMS

Two Things Our Nation Must Have In These Times:

Power to **SUSTAIN** itself ...there must be **FOOD**

Power to **DEFEND** itself ...there must be **ARMS**



ON MAY 29 an International Harvester dealer published the following statement in one of his local newspaper advertisements:

> "Daily it becomes more important that production of agricultural commodities continue unabated, and with utmost economy for all concerned. To that end the International Harvester Company, makers of Farmall tractors and other modern farm equipment, pledges a continuation of its service to the agricultural world. Through its dealers, scattered throughout this nation, it will maintain as long as humanly possible, efficient repair service, supplying necessary parts for repairs and adjustments and the most modern new farm machinery and equipment."

The picture above proves this dealer's point and symbolizes the double-barreled job to which this Company and the farm equipment industry are dedicating themselves today. Side by side at Tractor Works in Chicago, finished and ready to go, are trainloads of the machines of agriculture and the machines of war.

One train carries sturdy Farmall tractors, outward bound to the family farms of America, bringing new power to the essential job that must not stop, particularly in days of peril—the cultivation of the soil and the production of essential food.

The other train carries husky, Diesel-powered TracTracTors, painted olive drab and stenciled "U.S.A.," important parts of the new mechanized army. Hauling the big guns or doing other work, these tractors will be on the job wherever the loads are heaviest and the going toughest.

Farm tractor and Army tractor are made in the same factory, by the same skilled employes, from the same raw materials. They're both designed with the same engineering know-how, and held to the same rigid standard of quality. For *farms* or *arms*, in harvest field or on the march, these two tractors pull together toward the same imperative goal—the strength and security of the United States.

Fowler McCormick
*President*

INTERNATIONAL HARVESTER COMPANY
180 NORTH MICHIGAN AVENUE, CHICAGO, ILLINOIS

# INTERNATIONAL HARVESTER

# What This Mark Means to Agricultural Engineers

• One of your exacting jobs is the selection of materials in relation to design and efficiency of equipment and buildings.

As an agricultural engineer recently put it: "I can't know too much about materials; what they will do and how I can use them."

ARMCO Ingot Iron is one of these important materials, whether you are thinking about it as a galvanized sheet metal or an uncoated metal. It has these qualities, among others, to commend it:

**ARMCO Ingot Iron is a highly refined, uniform iron, originally developed in 1906 to give extra-durable service on the farms of America. It has excellent working and welding properties, and the longest recorded service of any of the low-cost ferrous metals.**

There is much more information we could give you, and we shall be glad to do so.

ARMCO Ingot Iron was the first special metal created for farm uses by The American Rolling Mill Company. Persistent ARMCO Research has since contributed others that you should know about. Tell us what your interest is and we shall see that you get the information you want.

THE AMERICAN ROLLING MILL CO., 2311 Curtis St., Middletown, Ohio

Please send technical bulletins on

☐ ARMCO Ingot Iron ☐ PAINTGRIP ☐ ZINCGRIP ☐ Stainless ☐ High Tensile

Name_____

Company or affiliation_____

City or town_____


# Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, assistant chief, Office of Experiment Stations, U. S. Department of Agriculture. Copies of publications reviewed may be procured only from the publishers at the addresses indicated.

RANGE, PASTURE, AND FIELD FENCING: RECOMMENDED PROCEDURE, *T. B. Chambers*. U. S. Dept. Agr., Soil Conserv. Serv., 1939, SCS-EP-17, pp. 10, pls. 5. This condensed guide was prepared to aid in securing uniformity of practice, economy, and effectiveness in the construction of the hundreds of miles of fencing required by the soil conservation program on purchased land and in the carrying out of conservation practice on numerous farms. Emphasis is placed especially on the selection of suitable types of fence, the materials required, and the more important methods of construction. Gates and cattle guards are also considered, and some working drawings for their construction are appended.

EROSION AND RELATED LAND USE CONDITIONS, U. S. Dept. Agr., Soil Conserv. Serv., Erosion Survey 12 (1940), pp. [1]+25, pls. 3, figs. 2, maps 2; 13, pp. [1]+31, pls. 5, fig. 1, maps 2; 14, pp. [1]+23, pls. 3, fig. 1, maps 2; 16, pp. [1]+35, figs. 13, maps 2. Conservation surveys are reported as follows: On the Hell and Mud Creeks Demonstration Project, Mississippi, by D. T. Webb; On the Mad River Watershed, Vermont, by C. H. Atkinson; On the Lake Crook Watershed, Lamar County, Texas, by H. Oakes; and On the Crooked Creek Project, near Indiana, Pa., by J. G. Steele and R. G. Mowrey.

SMALL IRRIGATION PUMPING PLANTS, *C. Rohwer and M. R. Lewis*. (Coop. Colo. and Oreg. Expt. Stas.) U. S. Dept. Agr., Farmers' Bul. 1857 (1940), pp. [2]+30, figs. 10. This publication supersedes Farmers' Bulletin 1404 which dealt only with wells as sources of irrigation water. The present publication deals also with the pumping of irrigation water from ponds, reservoirs, and streams, giving information designed to provide owners or operators of such farms as can practicably be irrigated with some indications of initial and operating costs, legal requirements, suitability of the available soil and water supply, and the sort of plant and equipment likely to be most satisfactory.

DETAILS OF CONSTRUCTION FOR A TRUCK EXCAVATOR, *D. A. Isler*. U. S. Dept. Agr., Soil Conserv. Serv., 1939, SCS-TP-28, pp. [2]+8+[6], pls. 8. This publication gives constructional detail, working drawings, and bill of materials for an attachment to be mounted on a 1.5-ton truck or larger. This type of excavator eliminates hand dumping and hand return of the scrapers, the machine is easily moved from one job to another, and the construction is neither costly nor complicated. The machine is designed primarily for maintenance work and works to best advantage where the bottom width does not exceed 3 ft, the depth 6 ft, nor the quantity excavated from 40 to 45 cu yd per 100 ft of length.

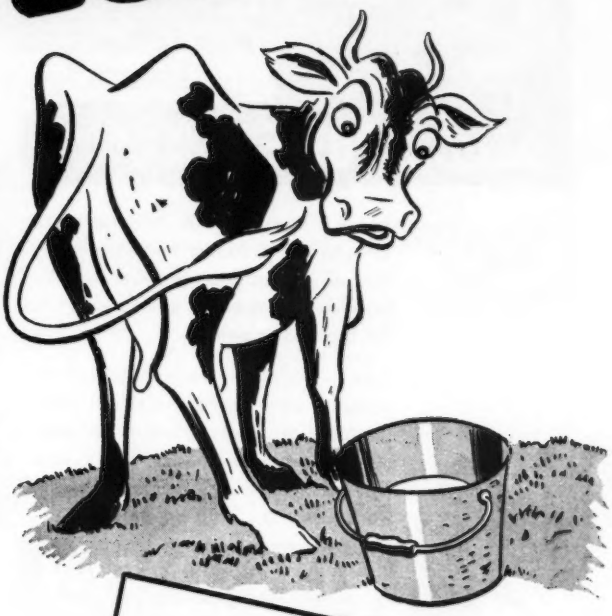
AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE ARKANSAS STATION, Arkansas Sta. (Fayetteville) Bul. 405 (1940), pp. 13-16, figs. 2. An experimental low-cost housing project, in which a four-room frame house of 768 sq ft of floor space and 10,000 cu ft volume was built for a total cost of $1,400, was carried out by D. G. Carter; and a home-made walk-in type refrigerator of 220 cu ft net inside volume was built at a cost of $1.66 per cubic foot, as compared with about $25 per cubic foot for commercially available household type refrigerators. A study of other sources of water for rice irrigation to replace or supplement the gradually declining well supply was made by K. Engler.

DESIGNS FOR SUSPENDED-LOAD SAMPLERS BASED UPON AN EXPERIMENTAL INVESTIGATION OF THE DISTURBANCES CAUSED BY THE INSTRUMENTS AND ANALYSIS OF SEDIMENT-LADEN FLOW, *J. P. O'Neill*. U. S. Dept. Agr., Soil Conserv. Serv., 1940, SCS-TP-33, pp. [49], figs. 23. Testing numerous grab samplers, both of the horizontal tube and the cutter types, the author found the Bakin cutter-type sampler to cause the least disturbance of flow in the sampling space. They were able, however, to reduce the disturbance of flow still further by removing the support rod from the center of the sampling space, eliminating the trip cord and a 0.25-in recess at the top of the sampling space, and using a thin-walled cutter tube. In the improved model here described and figured, the mechanism is supported from the rear and is enclosed in a streamlined housing. An additional improvement in flow pattern was secured on protecting the sampling space from the stream filaments diverted into it by the body sections, by means of thin horizontal plats placed above and below the sampling space and extending to the sides and upstream.

Appendixes 1, 2 and 3 contain complete drawings and specifications for a multiple-unit sampler and for two forms of the single-unit sampler. *(Continued on page 272)*

# SO-O-O BESSIE...

## You'll Have To Do Better Than That!



The government wants more milk—more butter—more cheese. Production must be increased . . . AT ONCE!

But how?

It takes three years to raise a dairy cow. We can't depend on larger herds to produce the immediate increases needed to supply the needs of a world at war. We must secure greater production from the dairy herds we have, through better feeding — better housing — better equipment and methods.

***If Jamesway water cups were installed in every dairy barn in America — that alone would result in the increased production asked for by our government.***

Jamesway Iron Silos, ventilation and sanitary equipment boost production still higher.

This isn't wild guessing—it's sober fact. For 35 years the James Manufacturing Company has been the leader in design and construction of barn equipment that increases production, saves labor and prevents waste.

Vital to success and profit at any time, good equipment becomes indispensable in a time of production emergency. It becomes doubly so, with the growing scarcity of farm help. For information that will help you get higher production with less labor — discuss farm buildings and equipment with your Jamesway man. Write — and he'll call. No obligation.

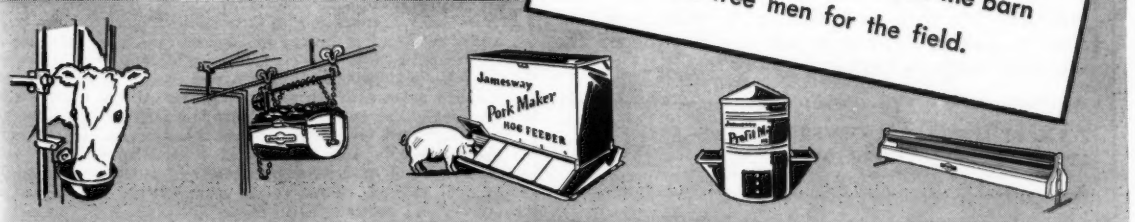
**JAMES MFG. CO., Dept. AD-741**

Ft. Atkinson, Wis. Elmira, N. Y. Oakland, Calif.

Jamesway

**Cows Help Themselves . . . Boys Do Men's Work**

Efficient dairy barn arrangement — automatic drinking cups—litter carriers and feed trucks cut chore time in half —enable women or boys to do the barn work, and free men for the field.




***JAMESWAY — All the Way*** . . . Self-feeders, waterers, feed and litter handling devices — essential barn, poultry and hog house equipment designed to increase production — conserve feed and labor.

*Wisconsin-powered Case Combine*

**Built-in POWER** TO FIT THE MACHINE AND THE JOB!

Illustrated is the sensational 4-cylinder **Model VE-4** 22 hp. engine. Weight, standard engine: 285 lbs.

Today, more than 300 manufacturers, in many industries, use Wisconsin heavy duty air-cooled engines either as built-in primary power or auxiliary power for their equipment.

Here is extreme compactness; light weight; air-cooled freedom from "weather grief"; economical operation . . . dependable power to fit your kind of equipment and your kind of work. Detailed data on request.

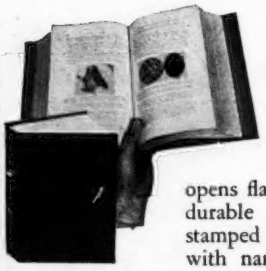
MOST POWER PER POUND — HEAVY-DUTY AIR-COOLED ENGINES

by WISCONSIN MOTOR CORPORATION
Milwaukee, Wisconsin, U. S. A.

*World's Largest Builders of Heavy-Duty Air-Cooled Engines*



## A Handsome, Permanent Binder *for* AGRICULTURAL ENGINEERING



*only* $1.40

The ONLY binder that opens flat as a bound book! Made of durable imitation leather, nicely stamped on front cover and backbone, with name of journal and year and volume number, it will preserve your journals permanently. Each cover holds 12 issues (one volume). Do your own binding at home in a few minutes. Instructions easy to follow. Mail coupon for full information, or binder on 10-day free trial.

..... MAIL COUPON TODAY .....

SUCKERT LOOSE-LEAF COVER CO.
234 West Larned St., Detroit, Mich.

*Mail postpaid.....binders for Agricultural Engineering for years.....*
*Will remit in 10 days or return binders collect.*

Name.....

Address.....

City.....State.....


# Agricultural Engineering Digest

*(Continued from page 270)*

TERRACE CONSTRUCTION WITH SMALL EQUIPMENT IN THE SOUTH, *W. A. Weld and P. M. Price*. U. S. Dept. Agr., Soil Conserv. Serv., 1940, pp. 11, figs. 6. It is pointed out that the drainage or channel-type terrace is the most satisfactory for runoff control. The construction of such terraces by means of the plow and scraper, plow and V-drag, one-way disk tiller, and the small-blade terracer or grader is briefly discussed and is illustrated by photographs and diagrammatic drawings.

## Literature Received

BALL BEARING HANDBOOK. New Departure, Division of General Motors Corporation, Bristol, Conn., has just issued the 15th edition of its handbook, listing the principal types and sizes of the forged steel ball bearings. This book has a new finger index for quick reference, and in addition to dimensions, capacities, tolerances, and mounting fits, contains new data to simplify the selection of bearings for various loads and length of service. Copies will be furnished on request for designers, draftsmen, and others concerned with the selection and application of ball bearings.

## EMPLOYMENT BULLETIN

**The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.**

### POSITIONS OPEN

EXTENSION ENGINEER wanted. The Agricultural Extension Service, University of Nebraska, wishes to fill a position on its staff of agricultural engineering. A man with thorough engineering training and with experience in the fields of irrigation and erosion control, as well as in extension work, will be given preference. Qualified persons, who desire to apply, should send credentials to Agricultural Engineering Department, University of Nebraska, Lincoln, Nebraska.

JUNIOR ENGINEER, ($2000). The U. S. Civil Service Commission announces an unassembled examination for junior engineers, any branch, to meet an increasing need for their services in national defense work. Details are explained in announcement No. 51.

ENGINEERS (various grades, $2,600 to $5,600). The U. S. Civil Service Commission announces an unassembled examination for engineers, in grades from assistant to principal engineer. Agricultural engineers qualified in farm machinery are indicated in a list of those particularly needed in connection with the national defense program. Details are explained in announcement No. 69, issued April 7, 1941.

INSPECTOR, ENGINEERING MATERIALS. The U. S. Civil Service Commission announces an unassembled examination for men for the above classification of work in the Navy Department, in ratings of junior to senior inspector ($1620 to $2600). Details are explained in announcement No. 81.

### POSITIONS WANTED

AGRICULTURAL IMPLEMENT BLOCKMAN, with eleven years' sales experience with large manufacturer of farm equipment and three years in agricultural engineering in engineering college, desires position as sales or collection blockman with another similar concern or would consider a position as teacher in farm shop, national defense, or farm machinery research work. Age 37, excellent health, no bad habits. Married. Rural background. Credentials furnished upon request. Am now teaching in state university but will be available September 1, 1941. Can revitalize, give new direction and effectiveness to sales or collection efforts through original methods. Proficient in management, organization, financing. Would prefer Middle West. PW-338

AGRICULTURAL ENGINEER, also farm and supply manager, has had 20 years' experience in agricultural pursuits as manager of large farming enterprise and agricultural supply house, and as chief agricultural engineer of large irrigation development in the West. Has had technical training and practical experience in all phases of engineering and agricultural production, development, and marketing. Best of references. Forty-four years of age. Married. PW-341